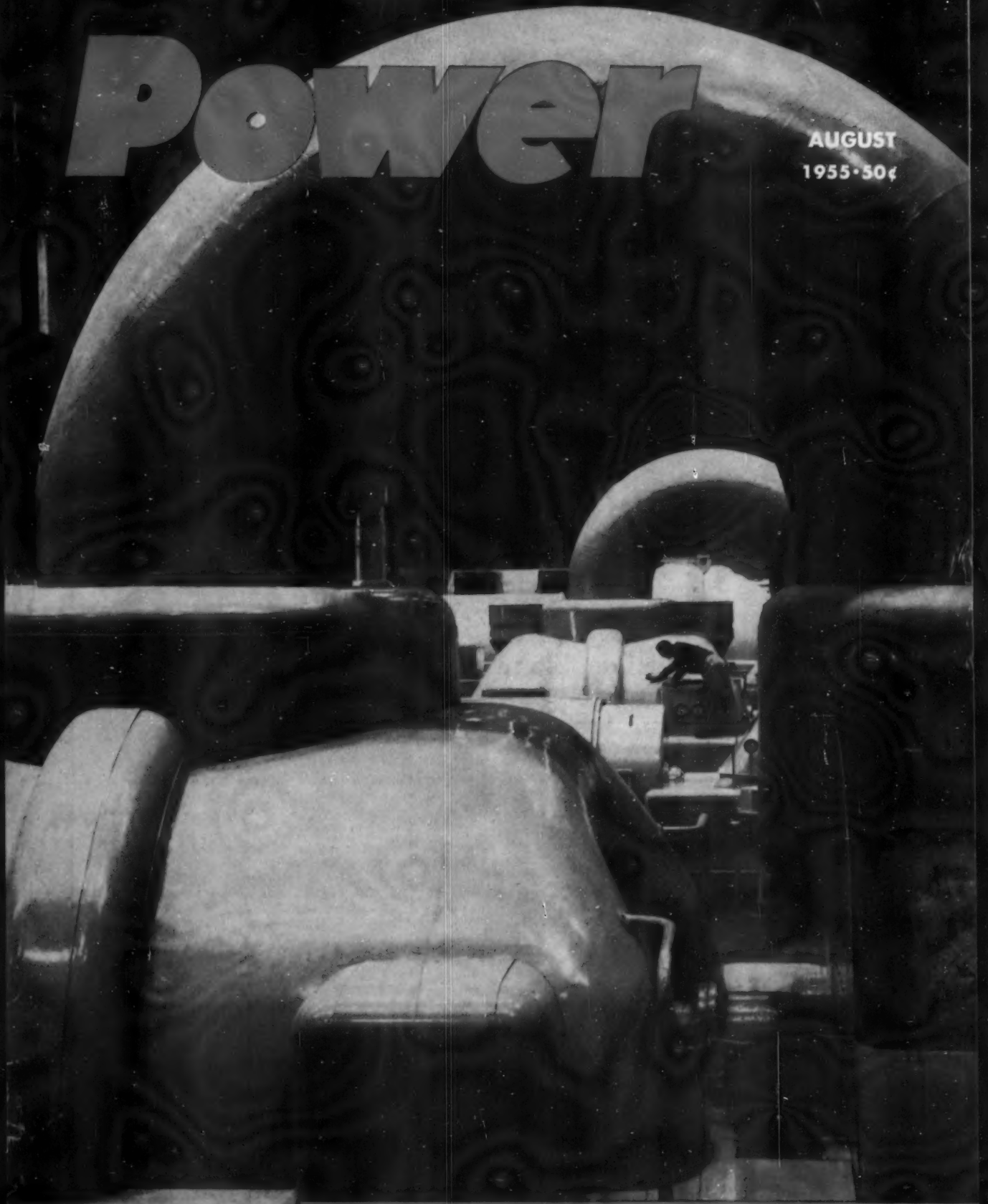
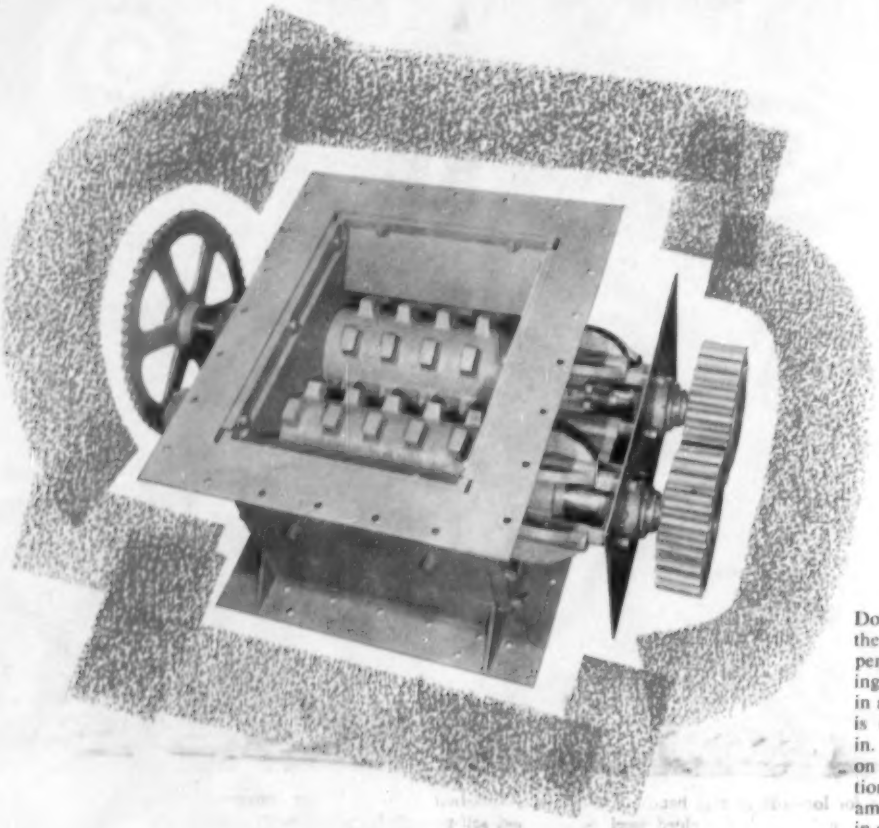
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

AUGUST
1955·50¢



Los Angeles steam plant capacity outstrips hydro • 3



Double roll construction of the A-S-H Clinker Grinder permits more efficient crushing. Unit can be installed in a closed system. Grinder is equipped with two 10-in. diameter rolls mounted on 12-in. centers for reduction of material to 2" diameter. Rolls are available in either 2 or 3 foot lengths.

New model double roll A-S-H clinker grinder assures uniform reduction of ash and slag

No more uneven sizing of ash and slag. No more clogging on wet materials. Will operate with rolls submerged. The A-S-H Clinker Grinder is especially designed to end these grinding problems.

Handles large clinkers — produces uniform product. This time-tested double roll design lets the A-S-H Clinker Grinder handle larger pieces . . . wet or dry . . . crush them more efficiently . . . with less grinder wear . . . and maintain the desired maximum size of end product.

Gives longer service life. The A-S-H Clinker Grinder lasts longer because double rolls crush ash and slag by *applying tremendous pressures at a few points* rather than by attrition. Rolls and teeth are integral castings of manganese steel which hardens under impact. Teeth are easily replaced. Rolls are welded to the shafts and shafts are machined after the welding operation.

Simplifies installation and maintenance. Grinder is a compact unit with rolls mounted in a fabricated steel housing so it can be installed in a closed system . . . and easily withdrawn *as a unit* for overhaul.

Grinds either wet or dry material. There's no danger of damage from water, grit or dust because bearings are mounted outside shaft stuffing boxes and are protected by lantern rings. With dry material, compressed air sweeps through glands and bearings to prevent entrance of grit. With wet material, water is used.

For more information on the A-S-H Double Roll Clinker Grinder write to Dept. A-1 at the address below.

The **Allen-Sherman-Hoff** Company

259 E. LANCASTER AVE., WYNNEWOOD, PA.

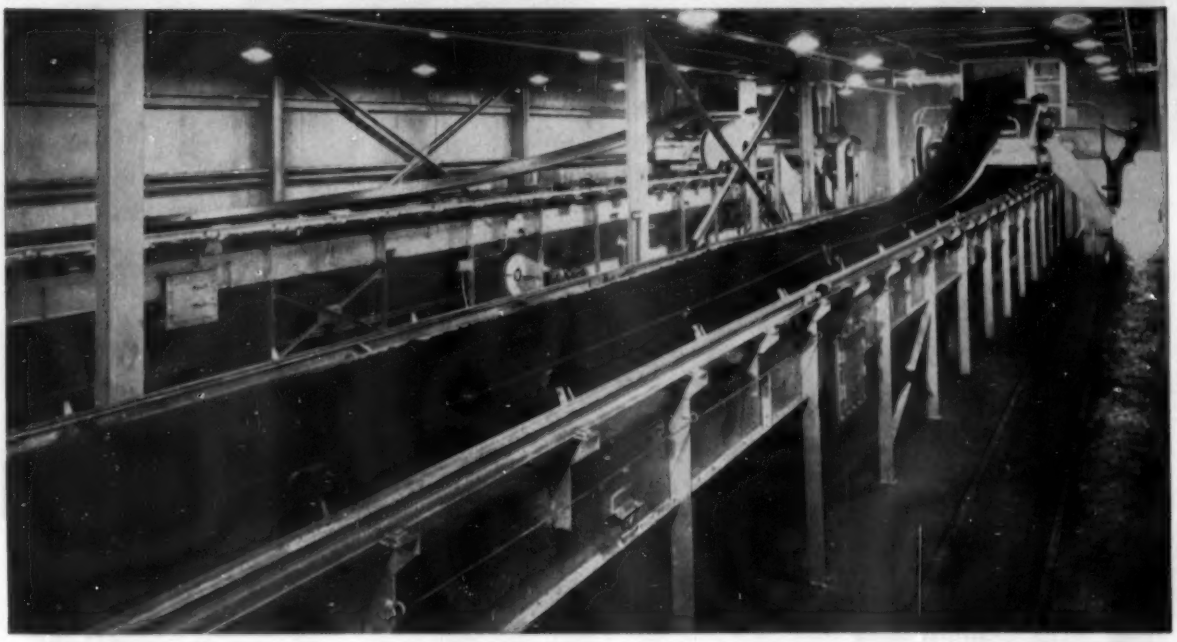
Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS

hydrojet *hydraulic* / **hydrovac** *pneumatic*

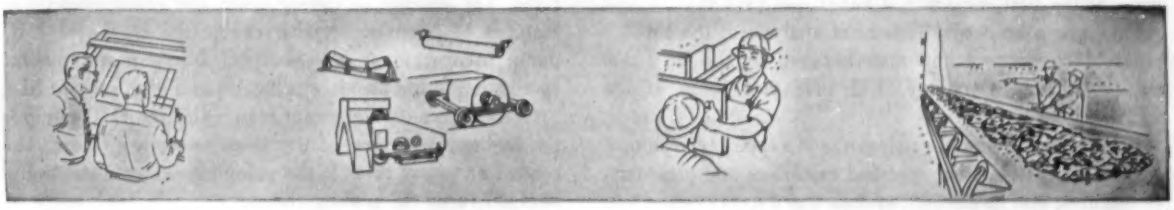
BEAT HIGH TRANSPORTATION COSTS--

carry the load via belt conveyors



Engineered for long-life in coal handling, these twin Link-Belt 36-in. wide belt conveyors employ Series 100 troughing idlers, welded steel pulleys, and self-propelled trippers with bunker seals.

LINK-BELT offers you the "total engineering" so necessary for top efficiency



DESIGNED FOR OVERALL EFFICIENCY

Because of its unrivalled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit conveyors into your system requirements.

BUILT FOR LONG-LIFE PERFORMANCE

Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the job.

DELIVERS FULL RATED CAPACITY

Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews.

ASSURES SATISFACTORY PERFORMANCE

When you rely on Link-Belt as a single source for your complete system, Link-Belt accepts responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems.

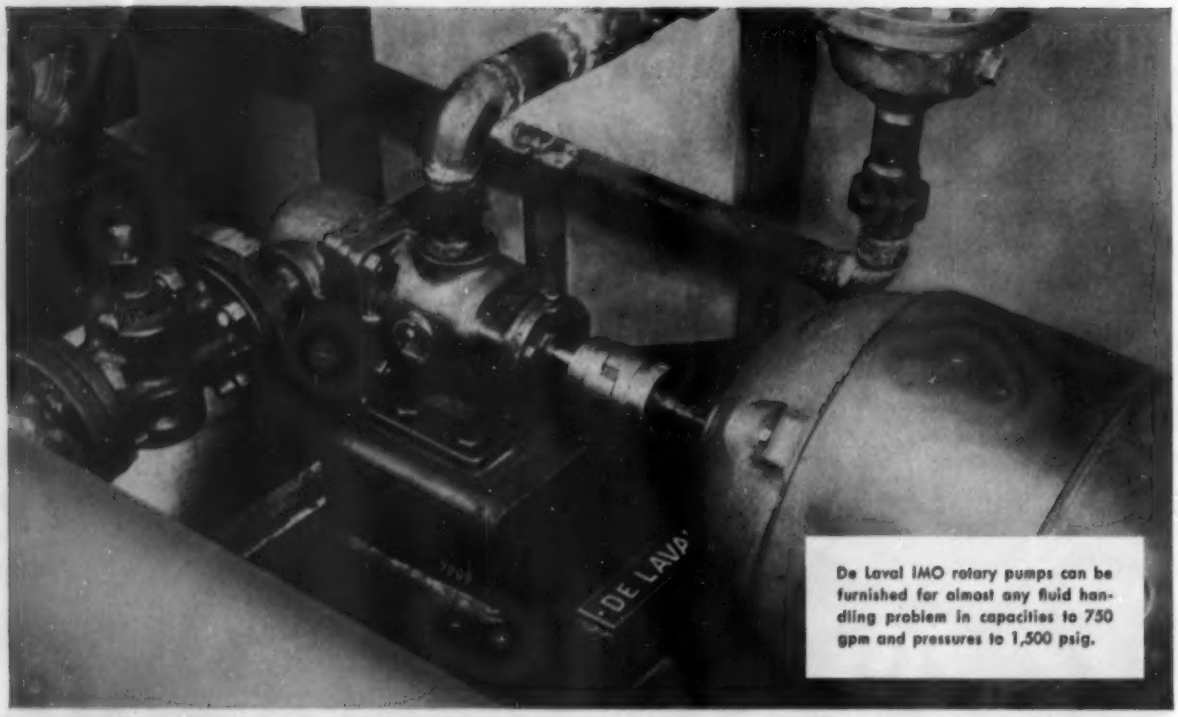
Next time you're in the market for one belt conveyor or a complete system, call a conveying expert in the Link-Belt office near you. It's his job to help you get the best in belt conveying at the lowest possible overall cost.

LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13,330-D



De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 1,500 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONGON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

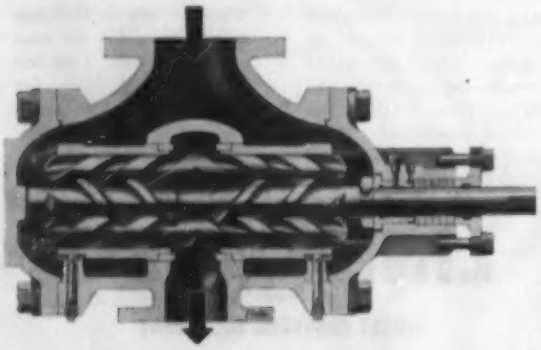
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

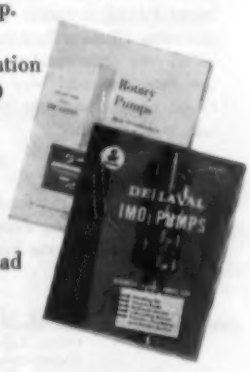
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



De Laval IMO Series A322A, a positive displacement, rotary screw type pump, can handle capacities to 750 gpm and pressures to 150 psig.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application*, contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 815 Nottingham Way, Trenton 2, New Jersey. DL-301



Power

AUGUST 1955 • VOLUME 99 NUMBER 8

ENGINEERING AND MANAGEMENT SECTION

Today's design in Valley Steam Plant ... 73
Air conditioning for multi-story buildings: Planning the system ... 78
Plan operations—then choose controls ... 82
Nuclear notes: news of latest developments ... 85
Aluminum weatherproof covering keeps heat insulation dry ... 86
Figuring design conditions for f-d, i-d fans ... 88
Rail-car mounted gas turbine meets power emergencies ... 91
Operate fuel system right to keep boiler burners supplied ... 92
Getting heat out of an atomic reactor: Nuclear study course, 12 ... 94
F-R turbine lubes are still under test ... 97
How to end false tripping in outdoor motor control ... 98
Data sheet: Watt loss in electrical conductors ... 101

PLANT OPERATION AND MAINTENANCE

Four steps to cut plant operating costs ... 105
Granular insulation protects hot underground pipe ... 108
Know how to heat residual fuel oil? ... 110
Blowoff-valve info you need before operating a steam boiler ... 112
How to recondition diesel fuel-injection equipment ... 114
New repair idea for large guide-bearing sleeves ... 116
It pays to rebuild large motors . . . sometimes ... 118
Magnetic amplifier trims maintenance of voltage regulators ... 119
Sweat-saving tips on repainting transformers ... 120
Alarm system gives fast check if bearings heat ... 121
Using turbine pump for condensate-return and hot-water jobs ... 122
Compressor trouble shooting is easy ... 124
Practical ideas ... 126
Plant problems ... 132
Arguments ... 138
How-to ... 140
Basics: No. 8 in a series ... 142
Marmaduke Surfaceblow ... 144

READER SERVICE SECTION

This month's service features 148
Reports from the field ... 150
Technical briefs ... 152
Plant equipment news ... 156
New free bulletins ... 165
George Edwards ... 168

Print order this issue: 47,284

AUGUST 1955 POWER Vol 99—No. 8

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional Handbook statistical number in September, by McGraw-Hill Publishing Company, Inc. James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W. 42nd St., New York 36, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising; J E Blackburn Jr, Vice-President and Director of Circulation.

SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W 42nd St, New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. Position and company connection must be indicated on subscription orders.

Single copies: U.S. and possessions, Canada 50¢ (except mid-September Handbook $1.00); all other countries $1.50. Subscription rates—U.S. and U.S. possessions: $4.00 for one year, $6.00 for two years, $8.00 for three years. Canada: $6.00 for one year, $9.00 for two years, $12.00 for three years. All other countries: $15.00 for one year, $25.00 for two years, $30.00 for three years. Entered as second-class matter January 26, 1949 at the post office at New York, N. Y. under Act of March 3, 1879. Printed in U. S. A. Copyright 1955 by McGraw-Hill Publishing Company, Inc. All rights reserved.

POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

WEST COAST steam plant capacity is overshadowing hydro . . . and latest expansion of the Los Angeles Dept of Water and Power is right in line with this trend. Cover shows an older sister-plant to the latest Los Angeles addition.

This shot of indoor Harbor Steam plant was made some time back by Martin Litton, photographer with the Los Angeles Times, during a routine overhaul. Camera caught unit No. 1 with it's insulation showing since protective casing was partially removed for scheduled inspection.

In contrast to plant on cover, newest on the L. A. system is the completely outdoor Valley Steam station, *p 73*. The new arrival is some 20 miles from the sea and one of the largest using cooling towers.

Next month . . .

Motor-driven exciters are shaping up in many quarters as favored over shaft-driven units for excitation of turbine generators; and their number is increasing. Upcoming article outlines the *why* behind this shift.

'Basics' series is in for a change. Sept will introduce *Fluid Facts*, starting with fundamental fluid properties. Later installments deal with the nature of fluids, how they act at rest, how to accurately predict their behavior in motion.

With liquids, vapors, gases, the life-blood of many power services, we think you'll agree the topic is well chosen.

Selecting people for maintenance jobs is an important part of many a power man's responsibilities. Kick-off article on the subject appeared back in December, followed with a second in June.

Next article appears in Sept when Dr Harold Seashore of the Psychological Corp, New York City tells what aptitude tests to use when selecting men.

Control system is outlined for Raritan River plant extension in this issue, *p-82*. If controls are down your alley, look for more dope in second part next month.

. . . and future months

Modern Plant Issue will be in your hands by mid-September. It's chock full of reference material for power men.

Looking for millionths of an inch to keep your Crane Valves tighter longer

How big is a micro-inch?

At Crane it's *mighty big* . . . because it is one of the noticeable differences between Crane Quality Valves and the run-of-the-bin kind.

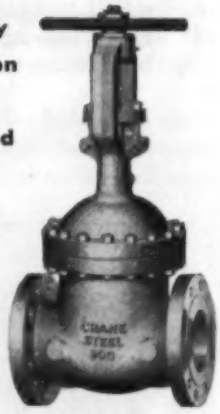
Measuring seating surface smoothness in micro-inches is the job of the Crane technician in the picture. His findings are important to keeping Crane production at the high-quality level.

Crane carefully measures seating surface smoothness to make sure that the Crane Valves you install will operate smoothly without seizure, seat tightly and wear longer, thus helping reduce your maintenance and repair costs to the minimum.

Such care in manufacture for more than 100 years is just *one* reason why thrifty buyers prefer Crane Valves . . . why industry keeps on using more Crane Valves than any other make . . . why you should always buy Crane.

Crane Co., General offices: 836 S. Michigan Ave., Chicago 5, Ill. Branches and Wholesalers Serving All Industrial Areas.

Better Quality
Bigger Selection
in Valves
for Every Need



CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

Power

L N ROWLEY *Editor*

B G A SKROTZKI *Engineering and Management*
S M ELONKA *Operation and Maintenance*
T G HICKS *Special Projects*
J J O'CONNOR *Managing Editor*
H P KALLEN *Assistant Editor*
C F SANDERS *Assistant Editor*
A S THORNTON *Assistant Editor*
S S WALDRON *Assistant Editor*
C F MARSCHALEK *Art Editor*
F A ANNETT *Contributing Editor*
P W SWAIN *Consulting Editor*

DOMESTIC NEWS BUREAUS: *Atlanta, Cleveland, Detroit, Houston, San Francisco, Washington*

WORLD NEWS OFFICES: *London, Paris, Bonn, Tokyo, Sao Paulo, Mexico City*

SHELTON FISHER *Publisher*
CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS
W W QUARLES, 330 W 42nd St., New York 36, N. Y.
J E DEAN, 330 W 42nd St, New York 36, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
L W ROMIGH, 520 N Michigan Ave, Chicago 11, Ill.
W K PONDER, 1510 Hanna Bldg, Cleveland 15, Ohio
R J McGURK, Continental Bldg, St. Louis 8, Mo.
S T HENRY, 801 Rhodes-Haverty Bldg, Atlanta 3, Ga.
J H CASH, First National Bank Bldg, Dallas 1, Tex.
R C ALCORN, 68 Post St, San Francisco 4, Calif.
H L KEELER, 1111 Wilshire Blvd, Los Angeles 17, Calif.

...lines and bylines

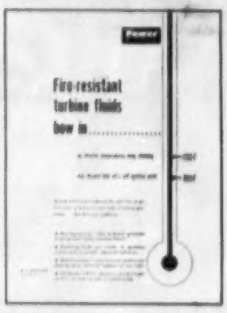
Ty Hicks in New York

Phil Swain in Sweden

TRAVEL forms a key part of every editor's job. And, like many Americans, their wanderlust carries over into vacation time. This summer, two POWER men are exploring by boat: Ty Hicks in a new cabin cruiser, Phil Swain sailing a *Folkboat* in Swedish waters.

For the summer months, Ty is limiting his boating to weekend-exploring of Long Island's south shore. *Reason:* he's still hard at work on a 20-page Refrigeration report scheduled for October.

TURBINE OIL AND COFFEE



After 4 years, the first

WITH breakfast coffee coming, POWER's Managing Editor Jim O'Connor sat with Dr. Henry Mahncke of Westinghouse and compared notes on lubrication doings. The 1951 Annual Meeting of American Society of Lubrication Engineers was in full swing at Philadelphia's staid Bellevue-Stratford Hotel.

Mahncke hinted industry once again was stirring the long-smoldering question of fire-resistant turbine lubes. Knowing the future importance of such a move, O'Connor tucked the thought in his mental file. Four years later, (March 1955) the results appeared in POWER—a pioneering roundup of all phases of the development of fire-resistant synthetic lubes.

Building such an editorial "first" calls for a keen knowledge of the field plus gaining the respect and confidence of men contributing to technical progress. It requires a capacity for fact-storing after tapping the right sources, and correct timing in publishing those facts. In this case, a casual comment was pyramided into a significant 5-page article by careful additions to the basic thought as each step in this technical development occurred.

Turbine designers at Allis-Chalmers, General Electric and Westinghouse offered their findings on suitability of the proposed synthetics as turbine lubricants. Researchers with chemical companies and lube engineers with oil suppliers were questioned on results of bench tests. But publication was held up pending field testing. The break came when Consolidated Edison fingered the phosphate ester type fluid for test operation in a boiler feed pump turbine.

Our March article stimulated further interest. So we ran a case-history roundup in July (p 90-91), pinning down 6 ways turbine oil fires had started. Now for an up-to-the minute progress report on the F-R turbine lubes, turn to p 97 in this issue.

Coming in December:

ATOMIC ENERGY TODAY

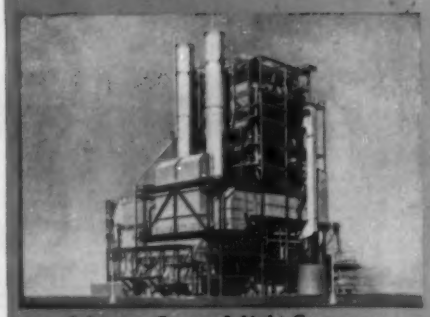
. . . a 24-page roundup of what's happening in the fast-moving nuclear field and what it means to power men.

WITH FACTS and figures on the current status of this new energy source and forecasts of its future, this progress report puts flesh on the bare bones of brief items in recent Nuclear Notes pages and shows how the fundamentals in our Nuclear Energy Study Course apply in practice.

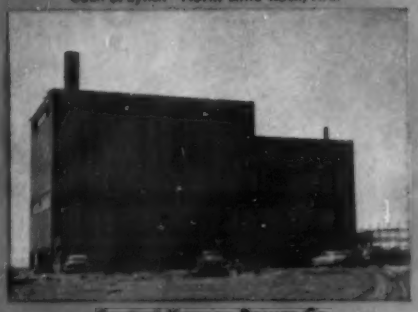
54 REASONS WHY ELECTRICITY IS AMERICA'S BEST BARGAIN

During the year of 1954 America's electric utilities broke all records in placing nearly 12 million kilowatts of new, highly-efficient generating capacity on the line. Over 6 million kilowatts of this new capacity are served by Babcock & Wilcox boilers. This is the greatest boiler capacity ever placed in operation during any year by a single boiler manufacturer.

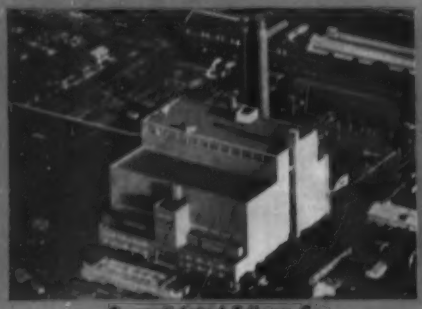
Pictured here and on the following pages are the 54 stations in which one or more B&W boilers were placed in operation in 1954.



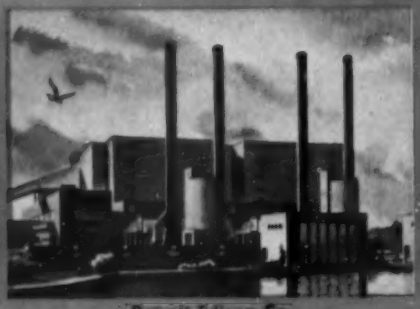
Arkansas Power & Light Company
Cecil S. Lynch North Little Rock, Ark.



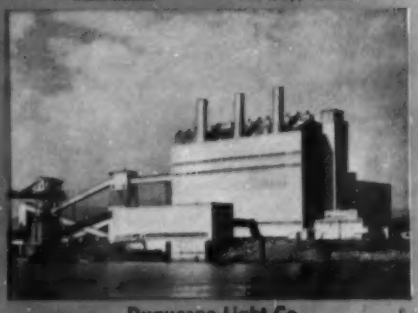
Central Kansas Power Co.
Ross Beach Hill City, Kans.



Consolidated Edison Co.
Astoria New York, N. Y.



Detroit Edison Co.
St. Clair Detroit, Mich.

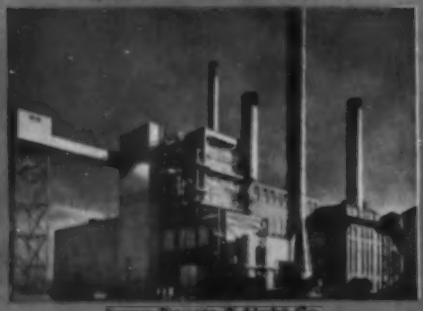


Duquesne Light Co.
Elrama Elrama, Pa.

City of Greenwood, Miss.
City Plant Greenwood, Miss.

Hartford Electric Light Co.
Middletown Middletown, Conn.

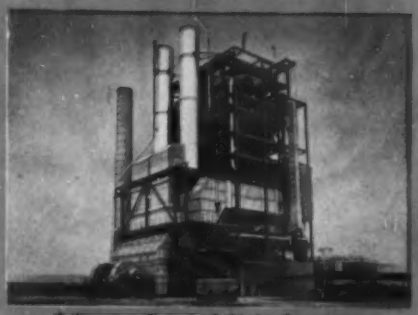
Hawaiian Electric Co.
Honolulu Plant Honolulu, Hawaii



Iowa Power & Light Co.
Des Moines Des Moines, Iowa

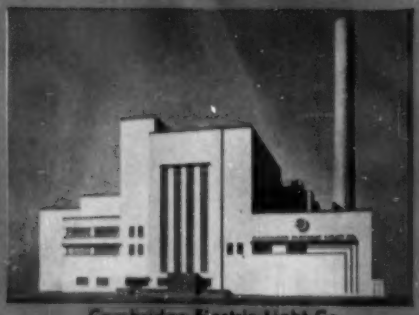
Iowa Southern Utilities Co.
Eddyville, Iowa

Kentucky Utilities Co.
Green River So. Carrollton, Ky.



Arkansas Power & Light Company
Harvey Couch — Stamps, Ark.

Atlantic City Electric Company
Deepwater — Deepwater, N. J.

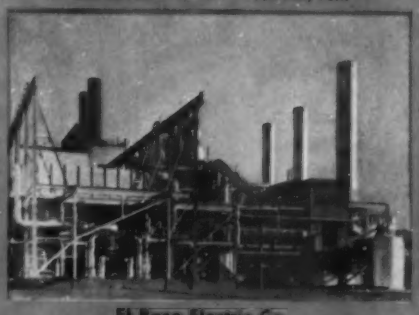


Cambridge Electric Light Co.
Kendall Square — Cambridge, Mass.

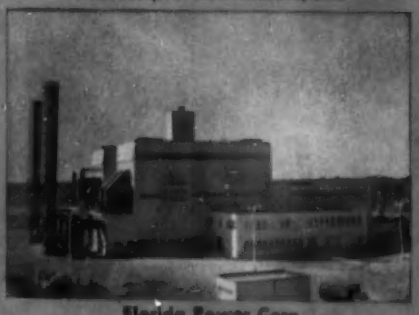
Central Power & Light Co.
Lon C. Hill — Lon Hill, Tex.

Cincinnati Gas & Electric Co.
W. C. Beckjord — New Richmond, Ohio

Commonwealth Edison Co.
Ridgeland — Stickney, Ill.



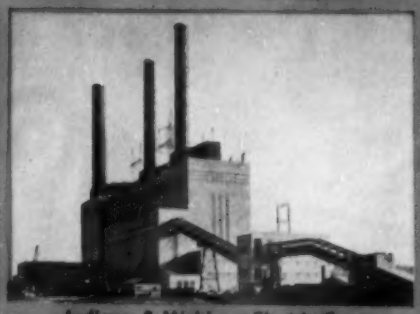
El Paso Electric Co.
Rio Grande — El Paso, Tex.



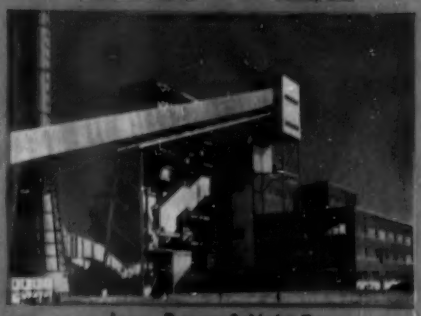
Florida Power Corp.
Suwannee River — Bluville, Fla.

Georgia Power Co.
Plant Hammond — Rome, Ga.

Houston Lighting & Power Co.
Webster — Webster, Tex.

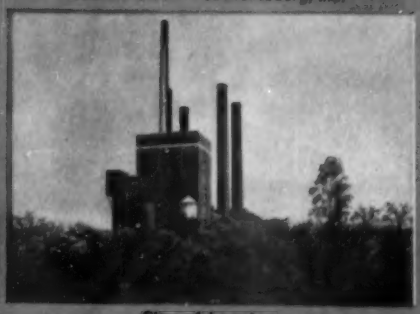


Indiana & Michigan Electric Co.
Tanners Creek — Lawrenceburg, Ind.

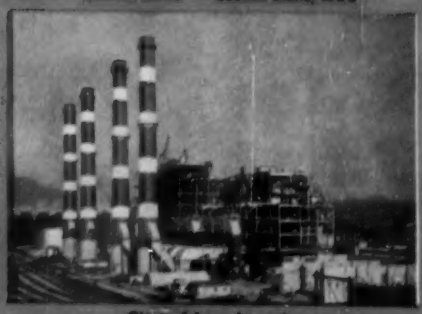


Iowa Power & Light Co.
Council Bluffs — Council Bluffs, Iowa

Lake Superior District Power Co.
Bay Front — Ashland, Wis.



City of Lansing
Moores Park — Lansing, Mich.

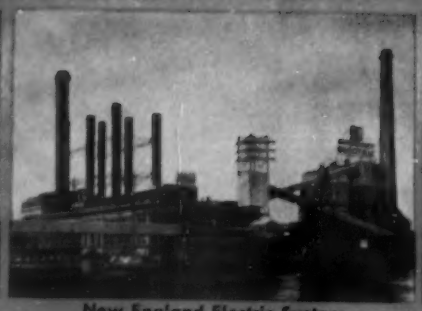


City of Los Angeles
Valley — Los Angeles, Calif.

continued on next page

← continued from preceding page

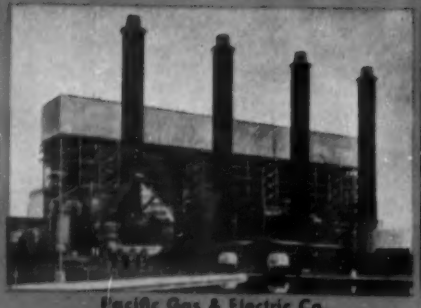
Missouri Public Service Co.
Ralph Green — Pleasant Hill, Mo.



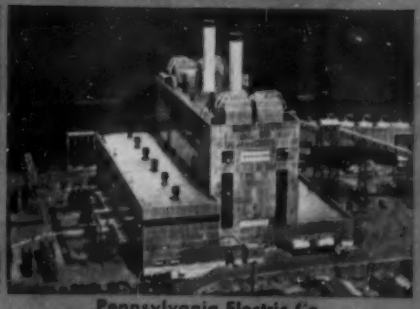
New England Electric System
South Street — Providence, R. I.

New Orleans Public Service Inc.
A. S. Paterson — New Orleans, La.

Orlando Utilities Commission
Orlando — Orlando, Fla.

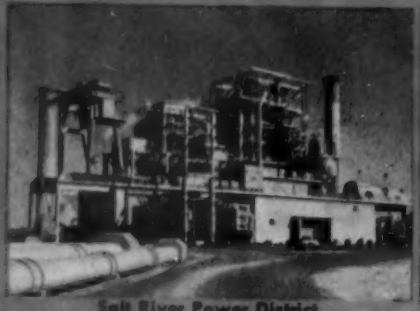


Pacific Gas & Electric Co.
Pittsburg — Pittsburg, Calif.

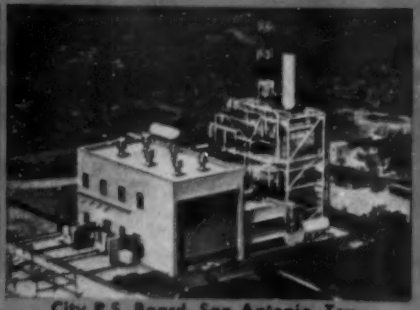


Pennsylvania Electric Co.
Shawville — Shawville, Pa.

P.S. Co. of Oklahoma
Southwestern — Weatka, Okla.



Salt River Power District
Kyrene — Tempe, Ariz.



City P.S. Board, San Antonio, Tex.
Northside — San Antonio, Tex.

City of Tallahassee
St. Mark's — Tallahassee, Fla.

Tennessee Valley Authority
Colbert — Tuscumbia, Ala.

Tennessee Valley Authority
Shawnee — Childs, Ky.

Tucson Gas, Elec. Light & Power Co.
De Moss Petrie — Tucson, Ariz.

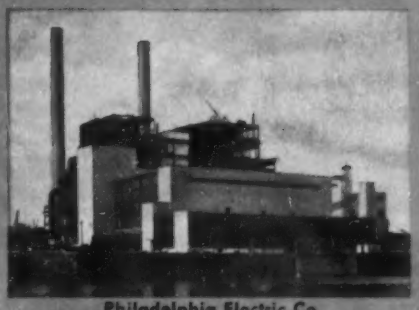
West Penn Power Co.
Springdale — Springdale, Pa.

Wisconsin Power & Light Co.
Rock River — North Beloit, Wis.

Niagara Mohawk Power Corp.
Huntley — Buffalo, N. Y.

Ohio Edison Co.
Niles — Niles, Ohio

Ohio Power Company
Muskingum River — Beverly, Ohio

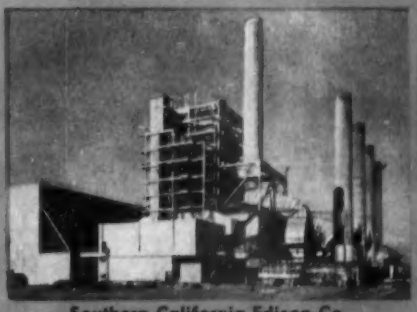


Philadelphia Electric Co.
Cromby — Phoenixville, Pa.

P.S. Co. of Colorado
Zuni — Denver, Colo.

P.S. Co. of New Mexico
Person — Albuquerque, N. Mex.

San Diego Gas & Electric Co.
Encina — Carlsbad, Calif.

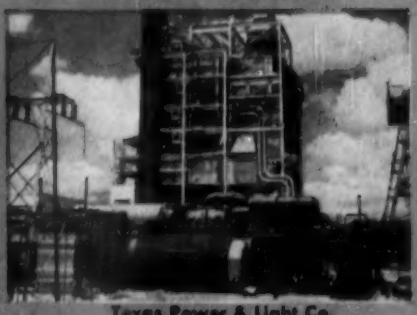


Southern California Edison Co.
Redondo Beach — Redondo Beach, Calif.

Southwestern Gas & Electric Co.
Lone Star — Morris County, Tex.

Tennessee Valley Authority
Widow's Creek — Bridgeport, Ala.

Utility
Southwestern United States



Texas Power & Light Co.
Rivercrest — Red River County, Tex.

Wisconsin Public Service Corp.
Weston — Rothschild, Wis.

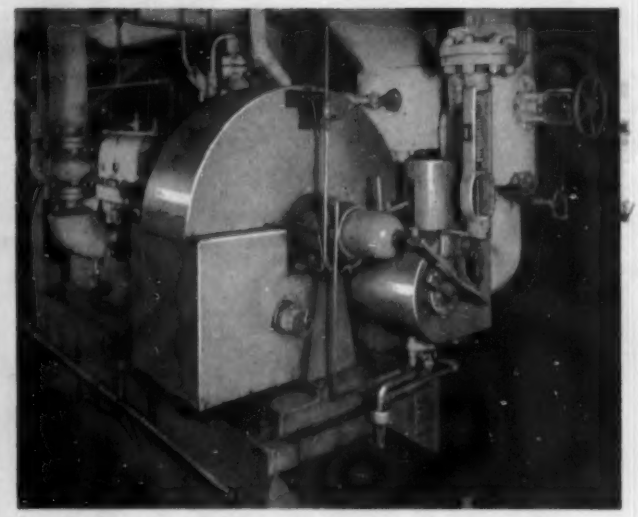
A continuing B&W program of intensive research and development in combustion and steam generation, with the cooperation of the Nation's electric companies, has made possible many major advances resulting in more efficient production of electricity. B&W Units installed during 1954 represent an important part of the contribution toward lower cost power.

BABCOCK & WILCOX

BOILER DIVISION

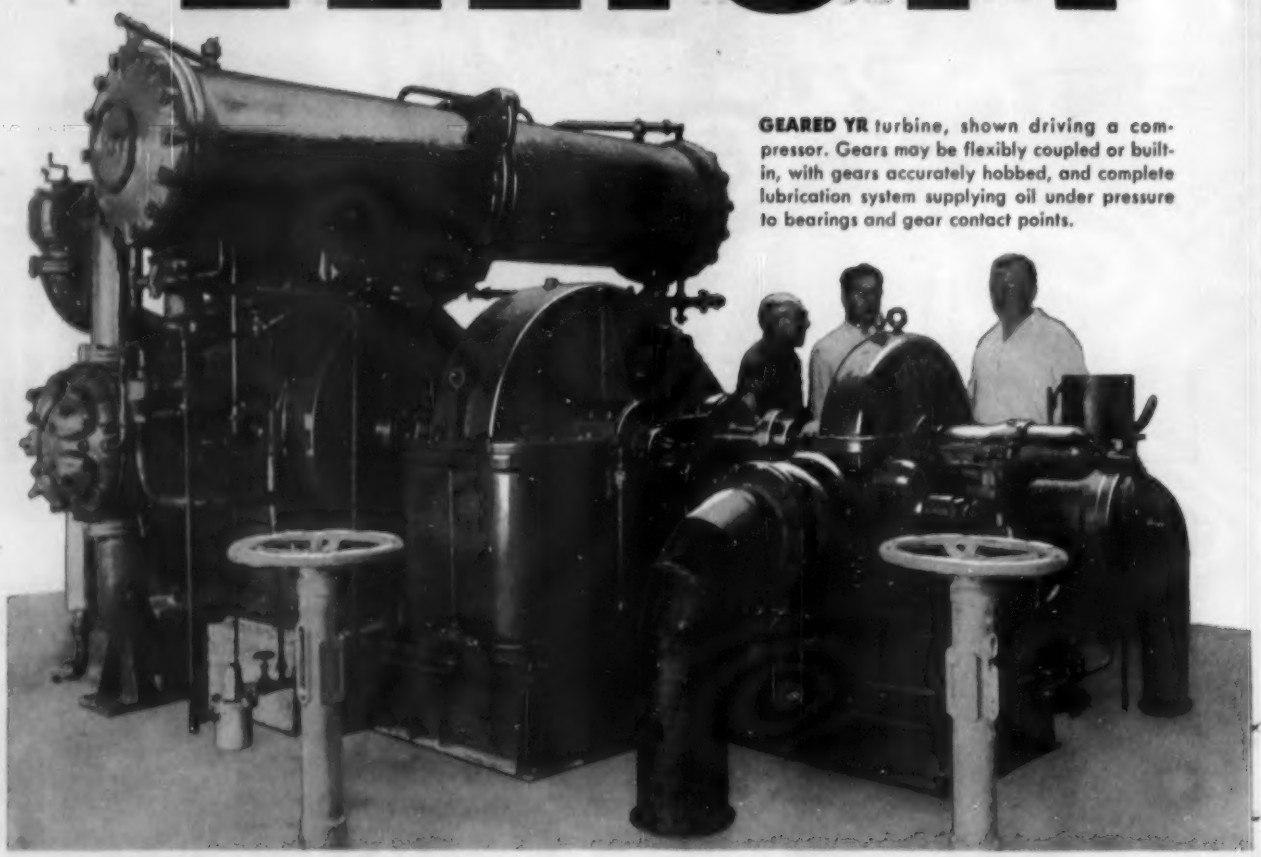
G-774

TYPE JR, shown driving a small pump. This is a simplified turbine design of rugged and reliable construction for low horsepower requirements and minimum first cost. Rated up to 45 hp, 4000 rpm. Maximum steam conditions—250 psig, 500 F. and 50 psig exhaust pressure.

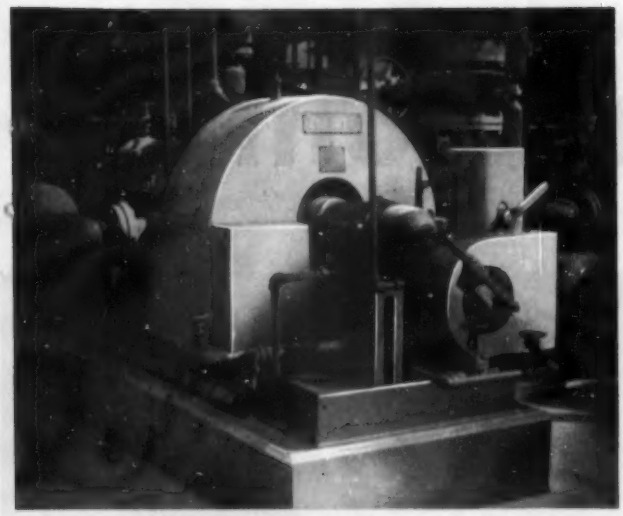


TYPE YR, here driving a boiler-feed pump. This is the standard Elliott mechanical drive turbine preferred all over industry. Five sizes—capacities up to 2000 hp, speeds to 7000 rpm. Steam conditions up to 600 psig, 750 F. and 75 psig exhaust pressure.

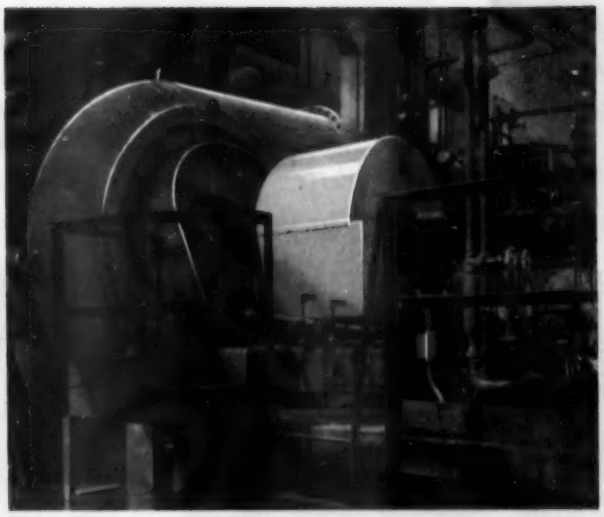
ELLIOTT



GEARED YR turbine, shown driving a compressor. Gears may be flexibly coupled or built-in, with gears accurately hobbed, and complete lubrication system supplying oil under pressure to bearings and gear contact points.



HIGH BACK-PRESSURE turbine, shown driving a boiler-feed pump in an oil refinery. These turbines using basic wearing parts of the standard YR, but with extra heavy casing and readily removable extra-packing glands. Good for exhaust pressures up to 250 psig.



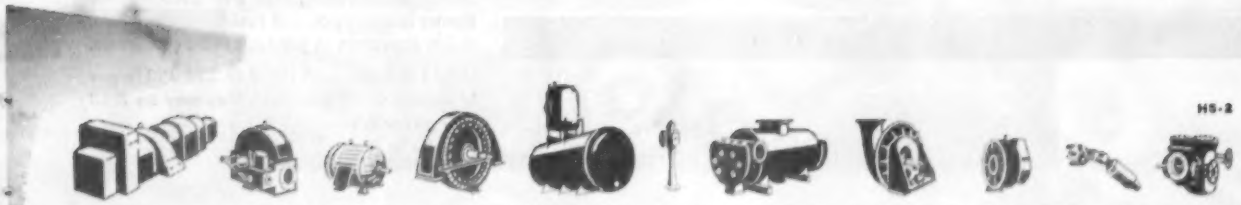
MULTISTAGE turbine, shown driving a compressor. Photo shows single-valve turbine, but multi-valve designs can be furnished. Speeds up to 11,000 rpm, steam conditions up to 850 psig, 850 F. Condensing and noncondensing ratings 400 hp and up. Custom-built to your requirements.

...the name you can depend on for all Mechanical Drive Turbine needs

WHATEVER YOUR REQUIREMENTS, the Elliott line of turbines can provide the simple, reliable answer. From the smallest type JR up to the largest multistage, Elliott mechanical drive turbines have the design, the construction and the flexibility to do the job right.

Contact your local Elliott field engineer or write Elliott Company, Jeannette, Pa. for information and descriptive bulletins.

ELLIOTT Company



HS-2

TURBINE-GENERATORS · TURBINES · MOTORS · GENERATORS · DEAERATING HEATERS · EJECTORS · CONDENSERS · COMPRESSORS · TURBOCHARGERS · TUBE CLEANERS · STRAINERS

How to Control

FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Room at Highgrove Power Plant of California Electric Power Co., Riverside, Calif. In this "outdoor" plant Bailey Control of Combustion, Feed Water, Steam Temperature, Air Heater Temperature, and Fuel Oil Temperature, assists operators in producing low cost steam.

Units 1 & 2 are each rated at 320,000 lb per hr capacity, 850 psi, 900F. They may be fired with gas or oil.

Steam Cost

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors too. Your power costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

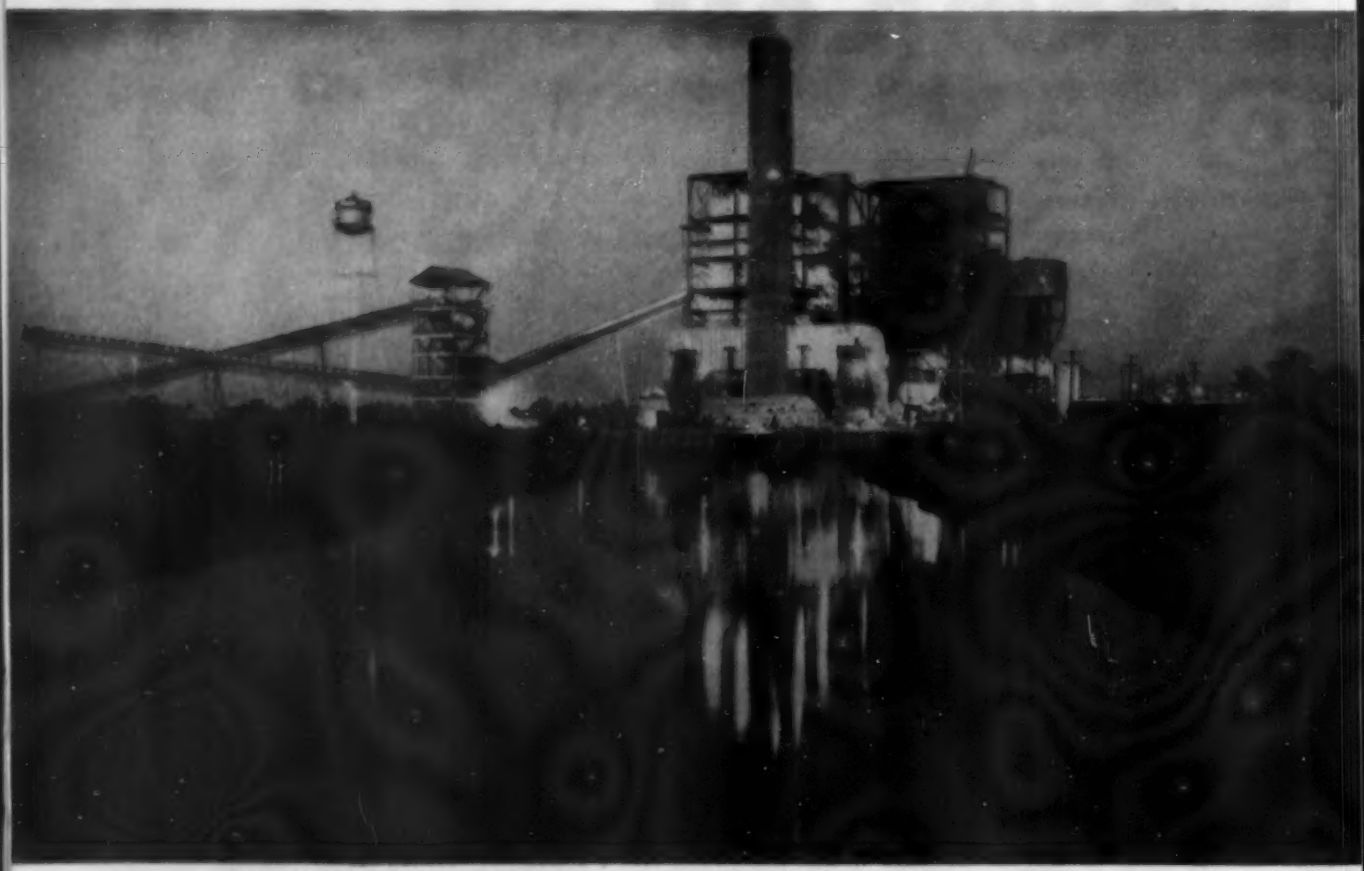
For close control of steam cost, more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-118-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

Copes-Vulcan helps to make MORE

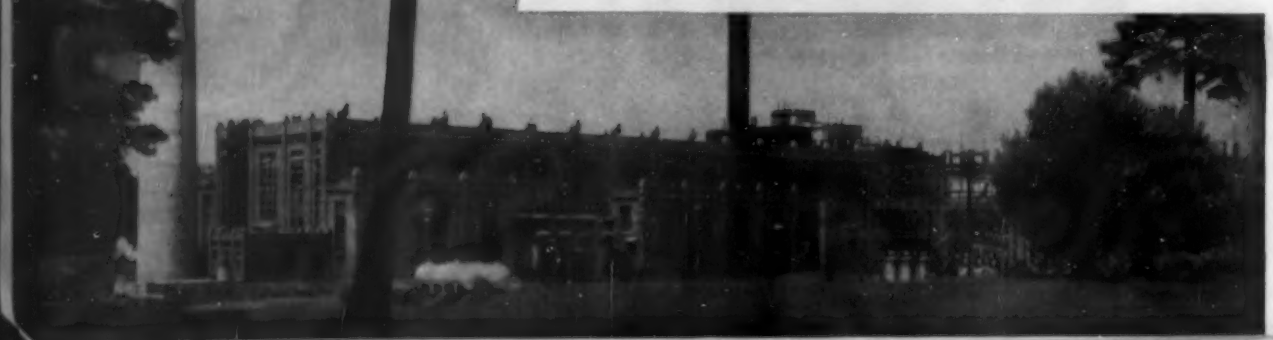


THE ALL-OUTDOOR Louis V. Sutton Steam Electric Generating Plant of the Carolina Power & Light Company at Wilmington, N. C. Copes-Vulcan Combustion Control, Boiler Feed Water Control, and Automatic-Sequential Soot Blowing help to maintain maximum boiler efficiency.

REPEAT ORDER for Copes-Vulcan Boiler Control and Pump Recirculation

from Carolina Power and Light Company for the Cape Fear Steam Electric Station

Copes-Vulcan maintains perpetual interest in every installation *after* it is in service. And throughout the life of the equipment, trained Copes-Vulcan servicemen will regularly visit the plant to check performance and see that everything is functioning as it should. If you'd like this attention on your jobs, give Copes-Vulcan a crack at the control and cleaning of your next boiler.



POWER FOR CAROLINA

At Carolina Power & Light Company's new outdoor installation, the Louis V. Sutton Steam Electric Generating Plant, steam is generated in two coal-fired boilers designed for 1750 psi at 1005 F. Unit 1 is a Combustion Engineering steam generator with a design load capacity of 950,000 pph. Unit 2 is a radiant-reheat Babcock & Wilcox boiler designed for 900,000 pph, with a reheat to 1005 F. Copes-Vulcan control helps keep these steam generators efficient.

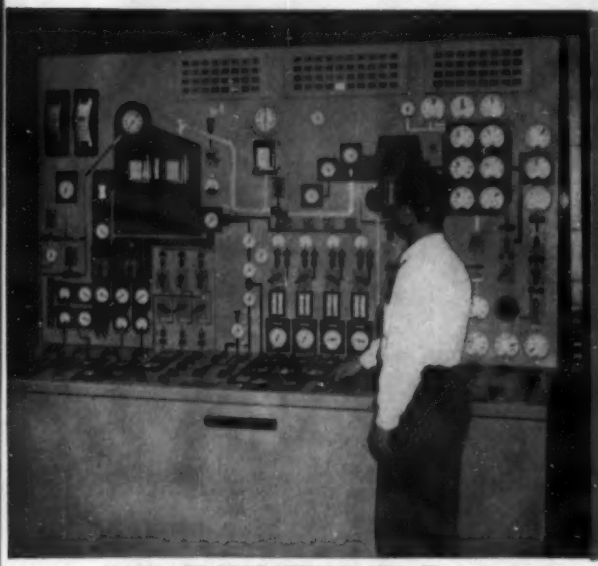
BOILER CONTROL

A Copes-Vulcan Combustion Control System accurately regulates the fuel and air for proper combustion. Copes Type 3-L Feed Water Control matches the feed flow to the steam demands and maintains a constant drum level. Copes provided 10-inch, 1500 pound standard motor-operated feed water by-pass control valves. Copes-Vulcan control and valves give automatic recirculation for protection of three boiler feed pumps.

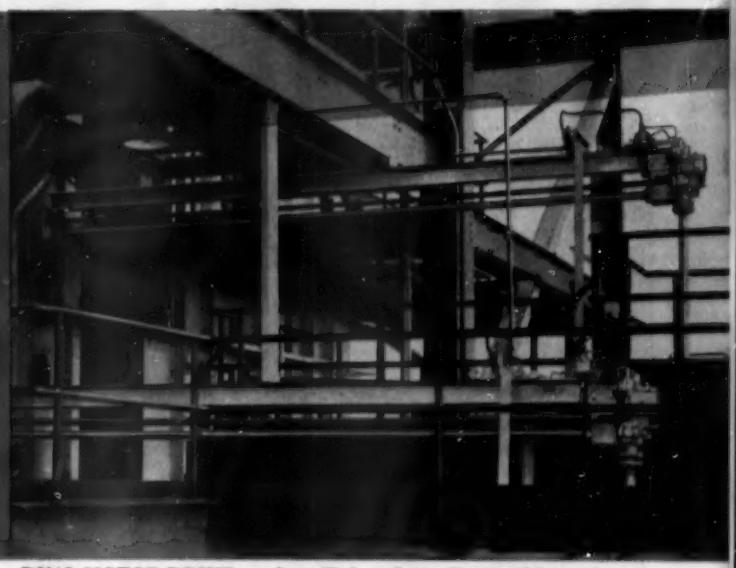
BOILER CLEANING

The Vulcan Automatic-Sequential Soot Blowing thoroughly cleans the heating surfaces. Air is the blowing medium in both units. Air motors drive the blowers in Unit 1; Electric motors drive those in Unit 2. Cleaning elements include Vulcan long retractables, wall deslaggers, rotaries, and air preheater cleaning controls.

Write for complete information about Copes-Vulcan Boiler Controls and Soot Blowers.



COMPACT OPERATING PANEL. There is one operator in the central control room at the Louis V. Sutton Generating Plant.



DUAL-MOTOR DRIVE on these Vulcan Long Retractables and the Vulcan Wall Deslaggers give more complete cleaning than single-motor drive, leaving *no* surface unblown.

COPES-VULCAN DIVISION

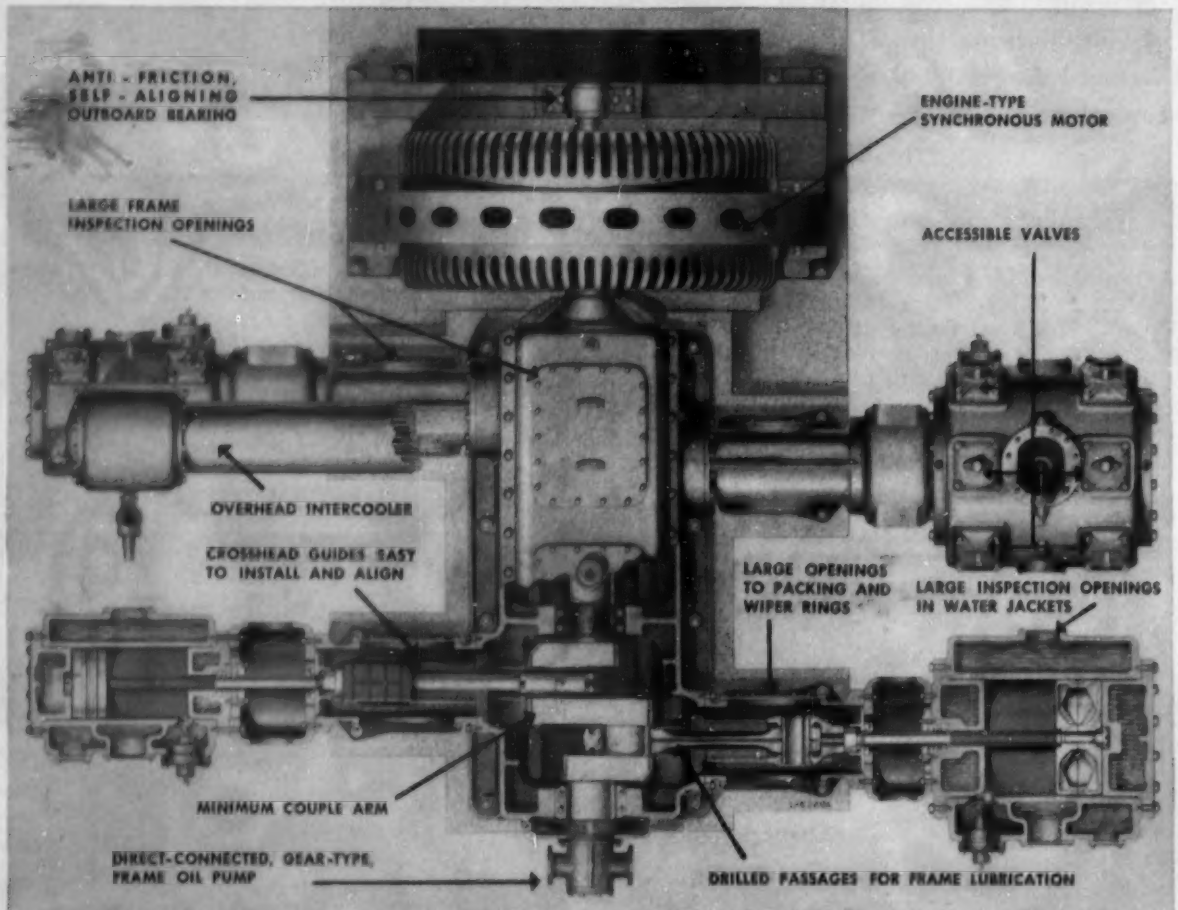
CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE 4, PENNSYLVANIA

We believe
ONLY THE HIGHEST QUALITY OF PRODUCT AND SERVICE TO OUR CUSTOMERS CAN BUILD A REPUTATION WORTHY OF OUR EFFORT.
Copes Vulcan

COPES VULCAN

Worthington Balanced Gives LOWEST OPERATING


ANTI - FRICTION, SELF - ALIGNING OUTBOARD BEARING
ENGINE-TYPE SYNCHRONOUS MOTOR
LARGE FRAME INSPECTION OPENINGS
ACCESSIBLE VALVES
OVERHEAD INTERCOOLER
CROSSHEAD GUIDES EASY TO INSTALL AND ALIGN
LARGE OPENINGS TO PACKING AND WIPER RINGS
LARGE INSPECTION OPENINGS IN WATER JACKETS
MINIMUM COUPLE ARM
DIRECT-CONNECTED, GEAR-TYPE, FRAME OIL PUMP
DRILLED PASSAGES FOR FRAME LUBRICATION

CUTAWAY OF FOUR CYLINDER BALANCED OPPOSED COMPRESSOR. Just one of the many multi-service cylinder arrangements available. Option of drivers gives full freedom in choice of power or fuel for maximum economy and convenience. Available drivers include: direct-connected engine-type synchronous motor *(shown)*; steam turbine through reduction gear; special induction motor; or direct-coupled internal combustion engine. Red areas show lubrication coverage.

"Easier to inspect and maintain than any similar compressor." That's what engineers say about the Worthington Balanced Opposed Compressor.

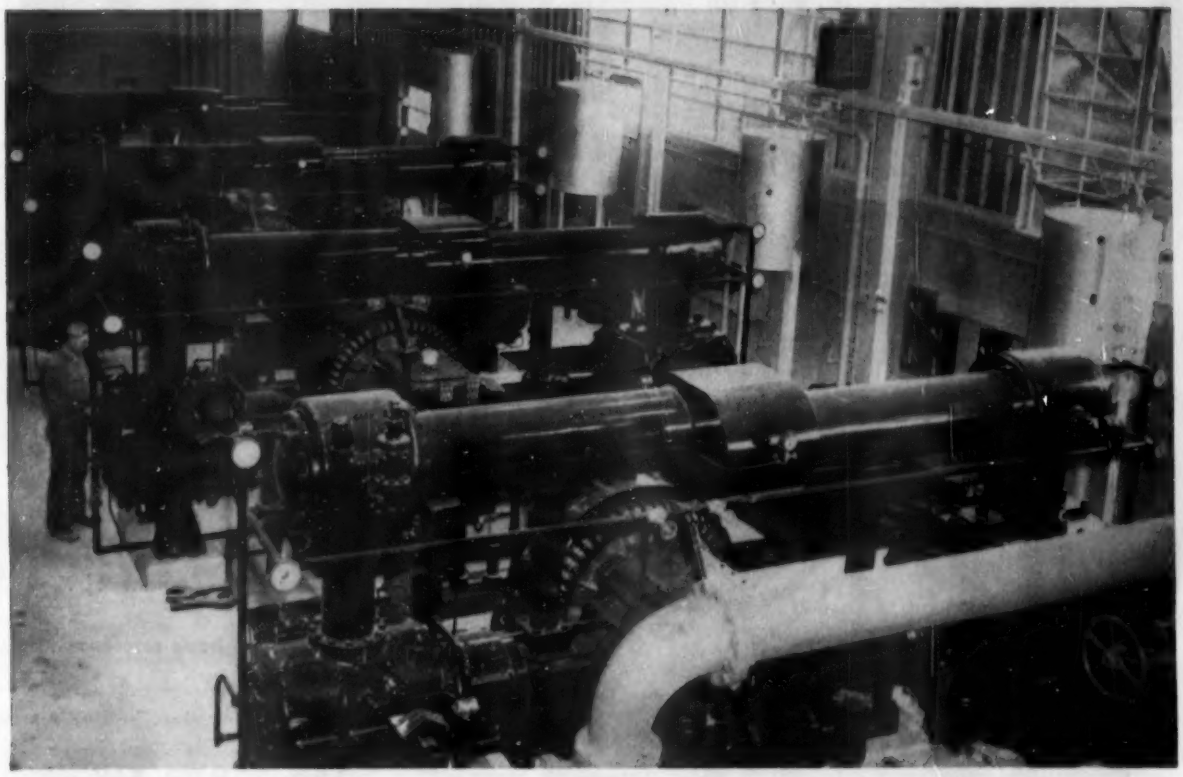
LARGE ACCESS OPENINGS are provided for inspection and maintenance of piston rod packing, oil wiper rings, water jacket, main bearings, crossheads, and crosshead guides. All valves are accessible and easily replaced. This easy accessibility of working parts facilitates *preventive* maintenance, reduces downtime for *corrective* maintenance.

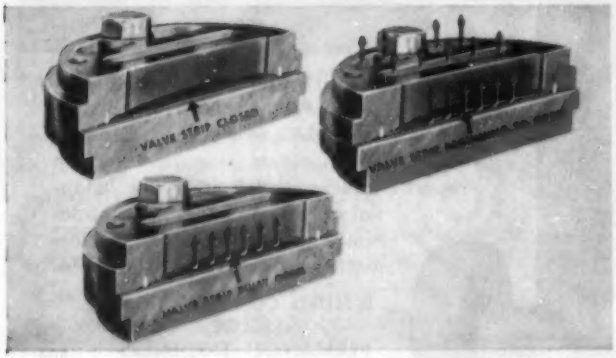
REDUCED INSTALLATION COSTS because foundations can be smaller. Inertia forces developed in one cylinder are bucked and largely cancelled out by similar and opposite forces developed in the opposing cylinder. Only a relatively small turning force, or couple is transmitted to the foundation. As a result, foundations are smaller for the balanced opposed than for equally rated compressors of other designs.

MAXIMUM STRENGTH, MAXIMUM STABILITY, result from the rugged one-piece-cast main frame and most stable construction of any similar compressor. Main bearing supports are integral with frame and reinforced with heavy steel tie bars over each bearing. Keyways in frame seat each tie bar and lock it in place, permanently preserving alignment.

AVAILABLE SIZES AND TYPES range from 300 to 10,000-hp with pressures from vacuum to 35,000 psig. A few applications include (figures indicate orders of magnitude only): *dry vacuum pumps* operating at very low pressures, *standard shop air compressors* (125 psig), *refrigeration gas compressors* (250 psig), and *multi-stage gas compressors* for use in service such as ammonia synthesis, methanol and hydrogenation plants (3500 to 35,000 psig). For more information, write for Bulletin L-679-B1 on company letterhead. Worthington Corporation, Section K.5.2, Harrison, New Jersey.

Opposed Compressor Design and MAINTENANCE COSTS





COMPRESSED AIR for Ford plant in Mahwah, New Jersey, is supplied by this array of four 450-hp, 100 psig Worthington Balanced Opposed Compressors.

HIGH-SPEED, LOW INERTIA Worthington Feather® Valve contributes to quiet operation and easy maintenance of Worthington Balanced Opposed Compressor. Thin, flexible strips of stainless ribbon steel form active elements. Curved guards hold strips in position over rectangular openings. Strips lift and flex uniformly against guards. Absence of impact results in quiet operation, longest valve life and low maintenance costs.

WORTHINGTON

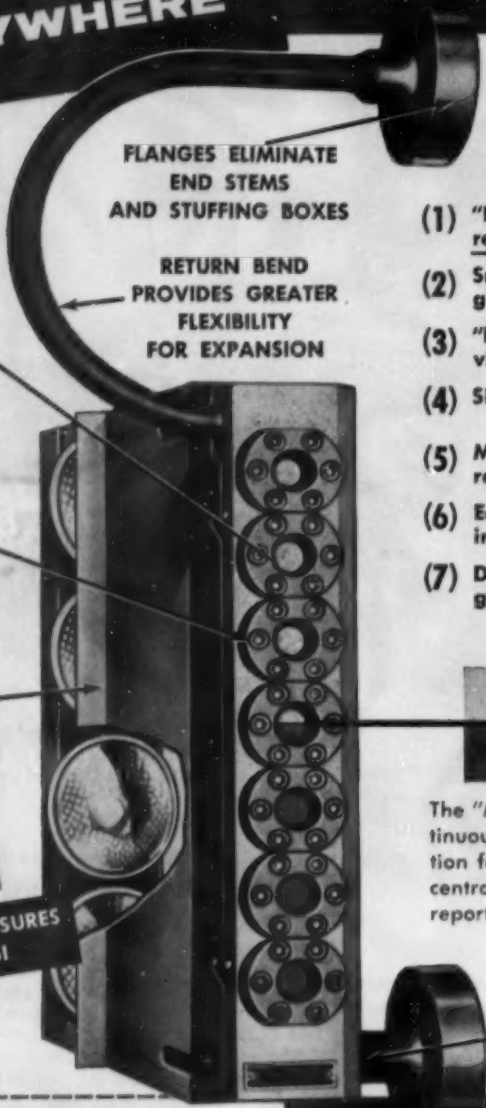
K-5-2

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

EARNING
WIDE
ACCEPTANCE
EVERYWHERE

DIAMOND "MULTI-PORT"® Bi-Color Gauge



SMALL ROUND INDIVIDUAL PIECES OF MICA AND GLASS

PORT PARTS REPLACED WITHOUT REMOVING GAUGE FROM BOILER

"HI-LITE" ILLUMINATOR

FOR BOTH NEW AND OLD BOILERS

FOR BOILER PRESSURES TO 3000 PSI

FLANGES ELIMINATE END STEMS AND STUFFING BOXES

RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION

STEAM SHOWS RED

WATER SHOWS GREEN

WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS

"MULTI-PORT" Advantages:

(1) "Bi-Color" principle shows steam red and water green

(2) Small round ports instead of long glass strips

(3) "Hi-Lite" Illuminator for improved visibility

(4) Simplified high-pressure construction

(5) Maximum thermal stability for rapid starting

(6) Easy, inexpensive maintenance . . . in place

(7) Direct reading . . . basic reference gauge

The "Multi-Port" gauge has been in continuous successful high pressure operation for more than two years in leading central station plants. Users everywhere report excellent readability and substantial savings in gauge maintenance costs. For additional information, write for Bulletin 1174.

7211

SEND TODAY

DIAMOND POWER SPECIALTY CORP. U
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 1174 explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

NAME_____

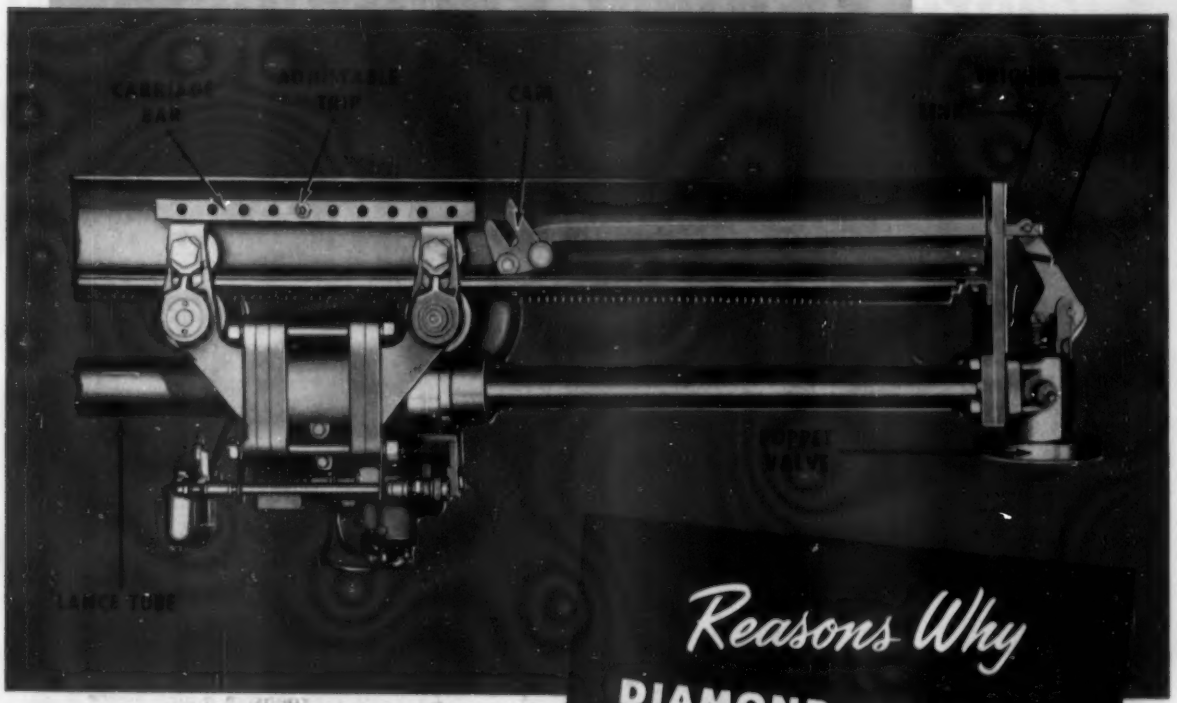
COMPANY_____

ADDRESS_____

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited—Windsor, Ontario

One of a Series

MECHANICALLY OPERATED VALVE



Reasons Why
DIAMOND BLOWERS
Assure
CLEANER BOILERS
at LOWER COST

The Diamond Model IK Long Retracting Blower has a valve mechanism that is simple . . . automatic . . . positive . . . accurate. As the lance tube moves into the furnace, carriage travel opens the valve through a mechanical linkage. As lance tube completes retraction, the action is reversed thus closing the valve. All pilot or diaphragm valve elements are eliminated.

Simple adjustment permits valve operation to be set at proper point for each individual blower. There is no critical adjustment for tight valve seating. The exclusive Diamond adjustable pressure control unit permits the quick and easy selection of blowing pressure to meet individual blower needs.

Other features contributing to the high cleaning efficiency and economy of the Model IK are Single Motor Drive with Positive Gear Translation and Rotation. Write for Bulletin 1080 for additional information.

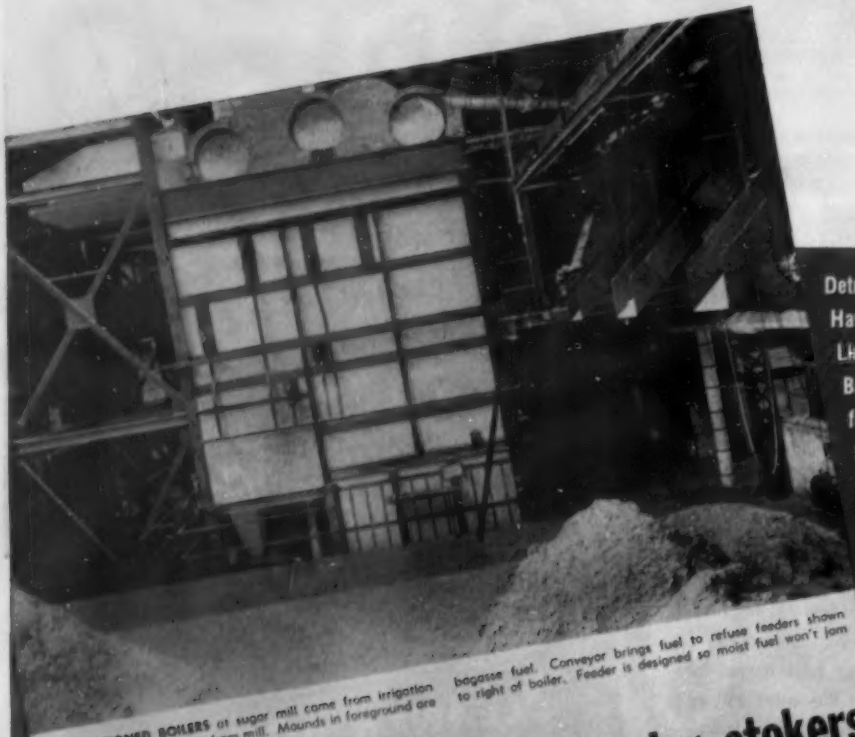
DIAMOND
POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

6772

Diamond Model IK Long Travel Retracting Blower with single air motor drive. Single electric motor drive also available.

More Efficient Refuse Burning

Read This Article in Power Magazine



RECONDITIONED BOILERS at sugar mill come from irrigation pumping plant seven miles from mill. Mounds in foreground are bagasse fuel. Conveyor brings fuel to refuse feeders shown to right of boiler. Feeder is designed so moist fuel won't jam

Mill burns residue with spreader stokers

Older boilers at sugar mill on island of Maui, Hawaii, gave poor bagasse firing efficiency, were hard to clean. So when time came for expansion, new units got modern firing equipment

By R H HUGHES, *Mill Department Head, Hawaiian Commercial & Sugar Co, Ltd*

► OUR EXPANSION PROGRAM at the P'unene Mill, largest sugar factory in Hawaii, called for additional steam-generating capacity amounting to 100,000 lb per hr. Bagasse, residue from making cane sugar, was to be the primary fuel for the boilers furnishing this added steam.

Before expansion, all the boilers were fired with bagasse in step-grate furnaces with natural draft. Poor bagasse firing efficiency and furnace ash disposal difficulties dictated that we look for more modern firing methods for any new units at the cane-sugar-producing mill.

Decision to increase the mill capacity was made in 1951. And to get new boilers then meant extended delay in delivery because of the Korean conflict. Luckily the company had two 800-hp oil-fired Stirling boilers available. These units were at the recently electrified water pumping plant about seven miles from the mill. Inspection proved the boilers satisfactory for further use. So it was decided to go ahead on the basis of moving them to the cane-sugar mill.

Boilers. We contacted the manufacturer for a proposal for conversion of the units. Our needs were as follows: maximum continuous rating of 50,000 lb per hr per boiler operating at 150 psig, saturated steam; mechanical stoker equipment suitable for automatic combustion control for bagasse firing; mechanical removal of accumulated ash on grates.

The boiler manufacturers proposed removing certain generating tubes and

Detroit RotoStokers burn bagasse at the Hawaiian Commercial & Sugar Company, Limited, on the island of Maui, Hawaii. Bagasse is one of many types of refuse fuels, efficiently burned with Detroit Stokers. Others are wood bark, hogged wood, coffee grounds, nut shells, and corn cobs—either separately or in combination with coal, gas, or oil.

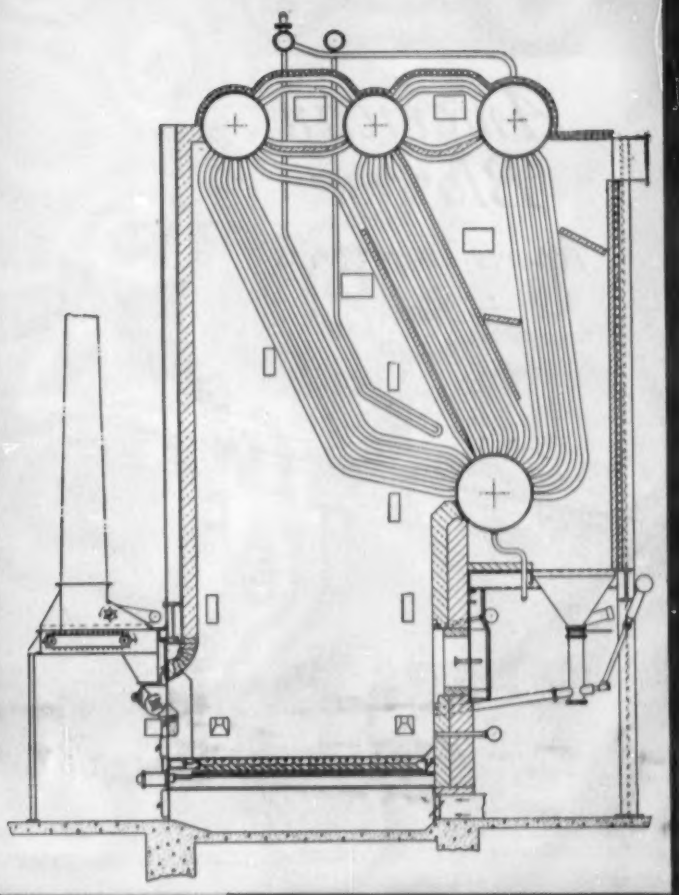
Detroit Stoker refuse conveyor feeders, an original design, automatically meter the fuel according to the load and in proportion to the air supply. The fuel is distributed evenly on the grate.

Each refuse burning installation is engineered to suit the fuel to be burned, the operating conditions, and the boiler furnace.

Write us for this reprint Bulletin 811

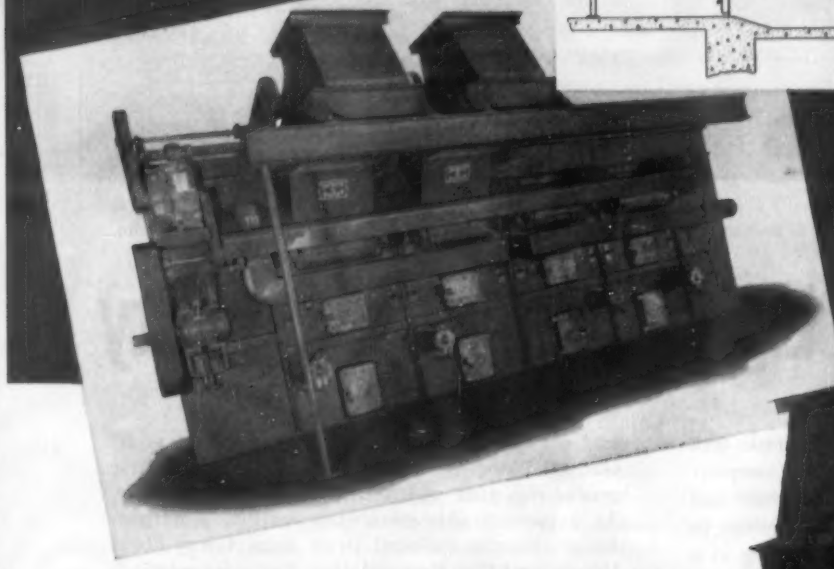
Your Print for Successful Refuse Burning

For producing low cost steam from refuse fuels, use Detroit RotoStokers equipped with refuse feeding rotor units and conveyor feeders. Uniform fuel distribution is assured. Rapid burning with high furnace turbulence is assisted by a properly designed overfire air system.

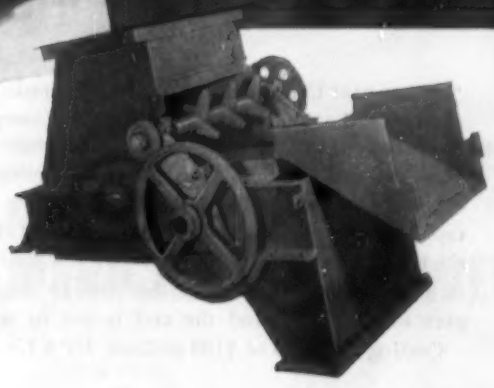


One of two Detroit RotoStokers with power operated dumping grates installed at Hamakua Mill Company, Limited, Paauilo on the island of Hawaii.

Capacity of this unit is 60,000 pounds steam per hour continuously, 72,000 pounds steam per hour maximum, burning bagasse fuel only.



Below is shown one of the refuse conveyor feeders of this Detroit RotoStoker, with hood opened to show the horizontal conveyor and feed control roll.



DETROIT STOKER COMPANY

General Motors Building • Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Mich.

Gadsby Plant, located on the outskirts of Salt Lake City, is the largest steam-electric generating station in UP & L's system.

Utah Power & Light doubles capability

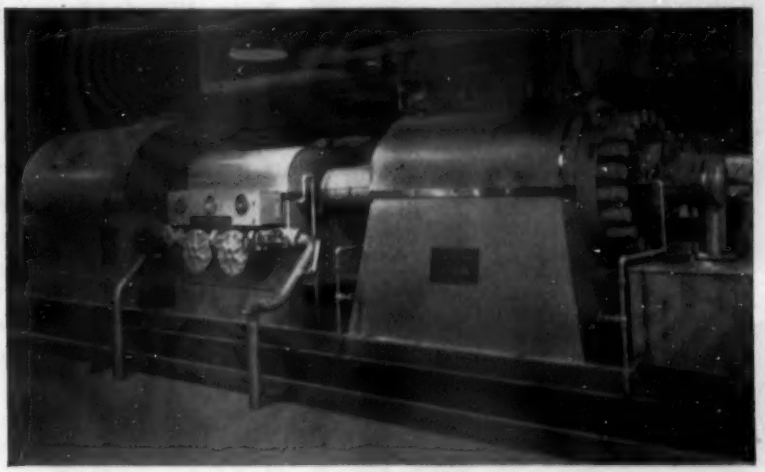
IN THE VAST Utah-Idaho-Wyoming-Colorado area where the Utah Power and Light Company serves some 700,000 people, raw minerals and chemicals are in abundance. Industries' influx to develop these natural resources is increasing at a rapid rate. So much so, that to keep ahead of rising electrical needs, UP & L has more than doubled its generating capability in the past 10 years to over 620,000 kw – and the end is not in sight!

Costing upwards of $109 million, UP & L's new and improved electrical facilities include – at its Gadsby Plant – a new 100,000 kw steam-electric generating unit which utilizes the reheat cycle. As a part of this efficient operation, American Blower Sirocco Induced Draft Fans, Gyrol Fluid Drives, and Gas Recirculating Fan were selected.

The important part American Blower plays in UP & L's expansion program is being duplicated in dozens of other progressive, investor-owned companies. Utility men across the nation depend on American Blower Mechanical Draft Fans, Fly

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS &

Completed in June 1955, UP&L's new 100,000 kw No. 3 unit (left) boosts Gadsby Plant capability to 241,000 kw. The unit's two American Blower Sirocco Induced Draft Fans are each rated @ 260,000 cfm @ 325° F @ 15.5" sp @ 860 bhp. American Blower equipment is also installed on units No. 1 and No. 2.



American Blower Type VS, Class 6 Gyrol Fluid Drives provide adjustable speed control of boiler feed pumps at Gadsby Plant. Rating is 2500 hp @ 3600 rpm.

with the help of American Blower

Ash Precipitators, Dust Collectors, Heavy-Duty Steam Coils, and Gyrol Fluid Drives for boiler feed pump and fan control. And so can *you!*

For whether your modernization or expansion calls for indoor or outdoor installations, American Blower makes *your* problems *their* problems — and supplies air-handling equipment to meet your exact needs . . . to deliver peak performance continuously. To talk over your plans with an experienced representative, give your American Blower Branch Office a call.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

LOOK WHAT'S HAPPENING TO BOILER WATER GAGES.

●There's a "new look" in water gages for high pressure boilers. You'll find it in every new YARWAY Flat Glass Boiler Water Level Gage.

YARWAY design and development engineers have made *twelve distinctive improvements* in YARWAY gages. All contribute to improved water gage service, longer water gage life.

Better Illumination—improved mercury vapor illumination makes meniscus "shine like a star".

Body Improvements—flanged connections and expansion bends eliminate stuffing boxes and *prevent distortion*—separated design in four-glass inserts permit freedom for expansion—stainless steel facing for gasket recess provides corrosion proof surface for the higher pressures—close machining tolerances insure top quality.

Improved Gaskets and Mica—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

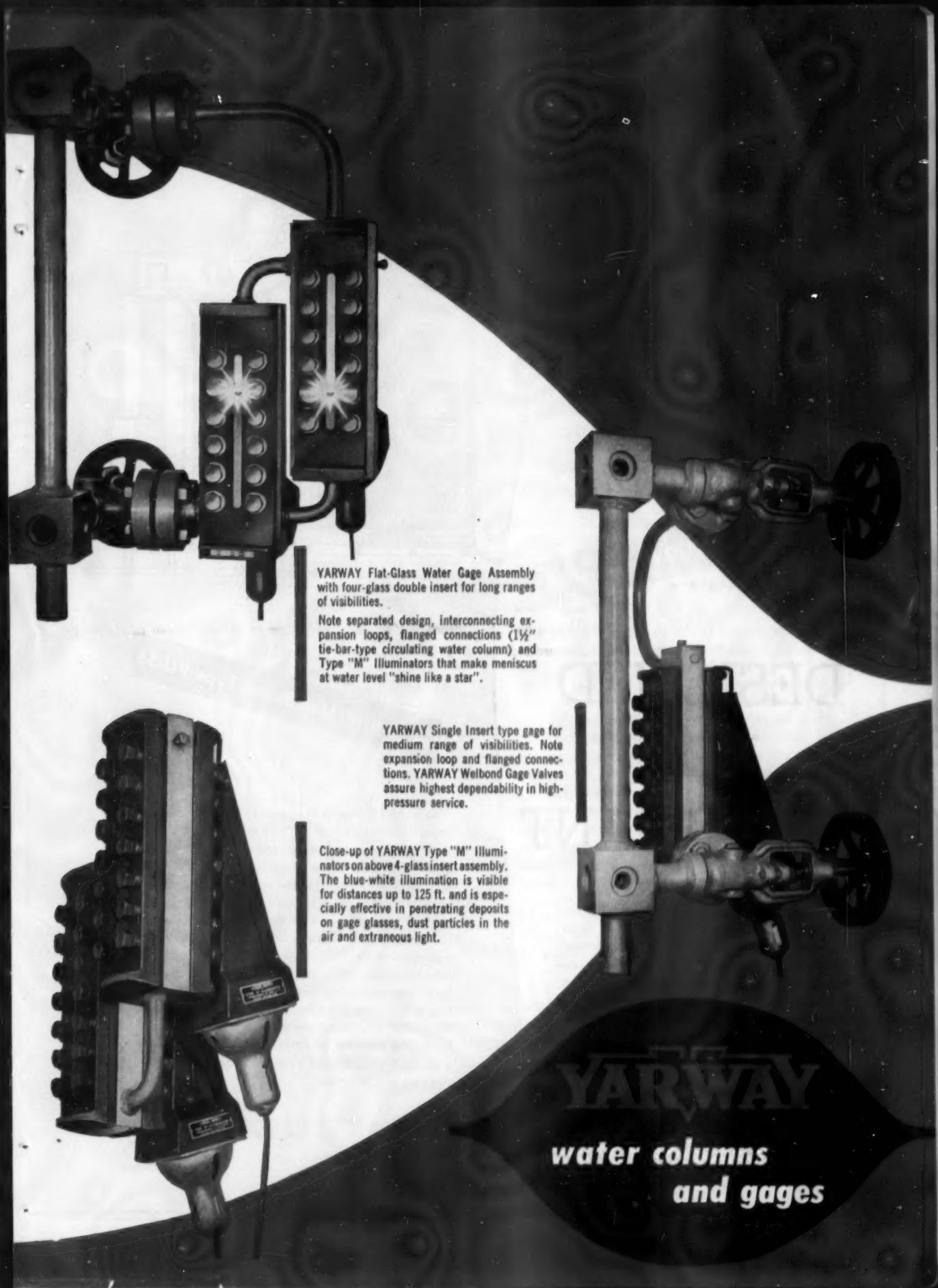
"Floating Assembly" Covers—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

Better Valves—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

Write now for new YARWAY Bulletin WG-1812.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".

YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

YARWAY

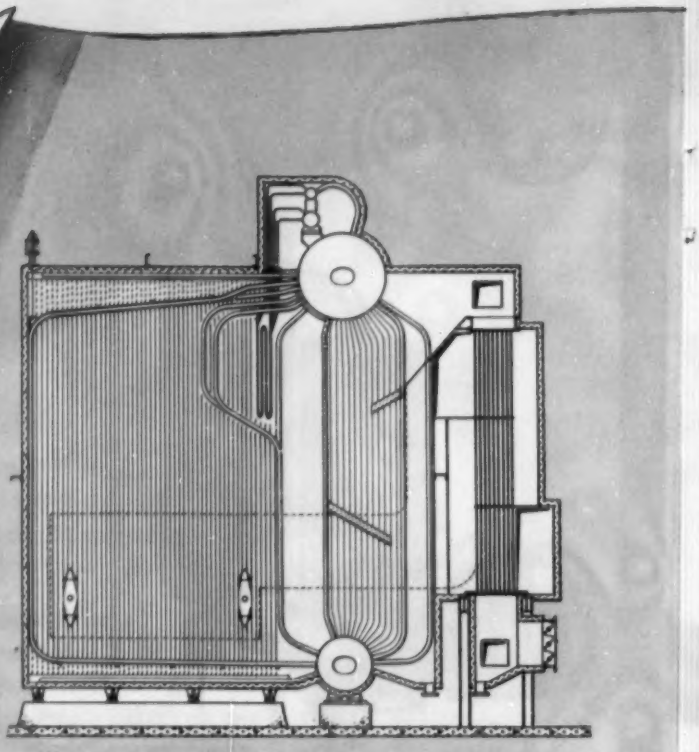
water columns and gages

one of these C-E standard boilers is . . . .

DESIGNED FOR YOUR PLANT

If your steam needs range between 4,000 and 120,000 pounds per hour, one of these versatile C-E Boilers will give you economical, standout performance. For while they are standard in design (which means lower first cost and proven performance), they're still *flexible* enough to be easily adapted to your exact requirements.

Chances are that one of the C-E standard boilers is the answer to your steam needs. But whatever they may be, C-E can fill them. For C-E Boilers are made in sizes and types for *any* capacity—for *any* pressure—*any* fuel or method of firing.

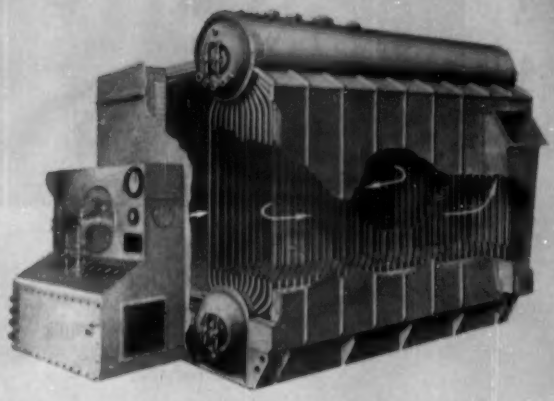


C-E Vertical Unit Boiler, Type VU-55

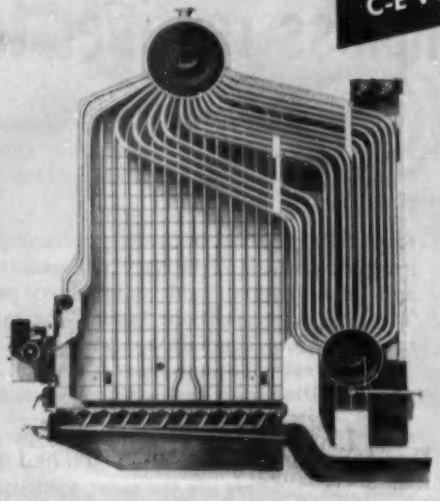
The VU-55 Boiler is available in six sizes ranging from 50,000 to 120,000 lb of steam per hr. It is designed for two pressure ranges—up to 250 psig and to 500 psig. These units are arranged for the application of superheater surface and heat recovery equipment if desired. VU-55 Boilers are designed for the pressure firing of oil or gaseous fuel and require no induced draft fan. They are equipped with tangential burners and tangent tube furnace walls to assure a level of performance which compares favorably with modern utility practice. The VU-55 Boiler is bottom supported requiring no supporting steel structure. The absence of exterior ductwork permits a smooth, streamlined exterior which is both attractive and practical.

C-E Package Boiler, Type VP

This completely shop-assembled boiler is available in fourteen sizes from 4,000 to 40,000 pounds of steam per hour... for operating pressures up to 500 psi... for pressure firing of liquid or gaseous fuels. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large lower drum—30-inch diameter—permits a simple, symmetrical tube arrangement... greater water storage capacity... easy access for washing down or inspection. A centrifugal fan, which operates at low speed and is exceptionally quiet in operation, is standard equipment. The simple baffle arrangement results in low draft loss... simple soot blowing... no dead pockets... high heat absorption. The VP is enclosed in a reinforced gastight, welded steel casing, and shipped completely assembled with firing equipment, fittings and forced draft fan. For foundation, it needs only a simple concrete slab.



C-E Vertical Unit Boiler, Type VU-10



The VU-10 is available in nine sizes from 10,000 to 60,000 pounds of steam per hour... for operating pressures up to 475 psi... superheat to 200° F in 20,000-60,000 lb range... for solid, liquid, or gaseous fuels. This boiler is a completely standardized design adaptable to many conditions. It is bottom-supported and needs no outside supporting steel. It operates efficiently over a wide range of output, and is easy to operate and to maintain. All parts are easily accessible for inspection. The VU-10 is a complete unit—boiler, furnace, setting, fuel-burning equipment, controls, forced draft, heat recovery equipment (if desired). Regardless of fuel, the same general cross-sectional arrangement of drums, convection bank and furnace wall cooling is used. Uniform design through each transverse section assures even water level in the drum and uniform expansion.

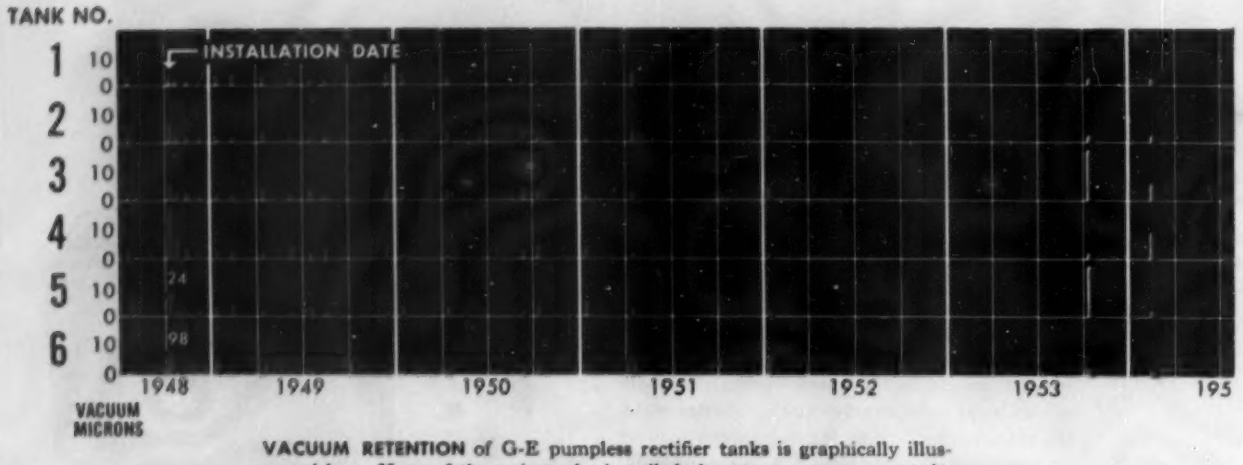
A C-E Industrial Boiler for Every Need — Combustion Boilers are available in many other 2-drum designs — for capacities up to 350,000 pounds of steam per hour — and to burn any commercially available fuel. All of these boilers can be designed for use with pressures up to 1375 psi and steam temperatures as high as 960 F — utilize any type of steam recovery equipment — fit difficult space conditions. Let us give you full details on the complete line of C-E Industrial Boilers, including the C-E LaMont Controlled Circulation Hot Water Boilers.

B-852

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE



VACUUM RETENTION of G-E pumpless rectifier tanks is graphically illustrated here. None of these six tanks, installed almost seven years ago at the Buffalo plant of the Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corporation, has ever required maintenance. This endurance test is conclusive proof that the G-E pumpless tank is an outstanding performer.

Not one cent has ever been spent for repairs on a G-E pumpless rectifier tank

Since 1948—when the first General Electric pumpless rectifier unit was installed—not a single customer anywhere in the country has paid out a penny for vacuum tank repair. And this is only a start. G-E engineers estimate a much longer life for this equipment. Here's why:

"PERMANENTLY-SEALED" TANKS, manufactured under almost antiseptic conditions, eliminate the need for a pumping system. This, in turn, eliminates such problems as mercury migration between tanks and the possibility of shutdown due to vacuum-system failure.

SUPERIOR MANUFACTURING AND TESTING methods have made this exclusive sealed-tank design possible. Tanks are assembled in a special air-conditioned room, then baked, pumped-down and sealed to assure the best possible vacuum. To check the possibility of even the most minute leak, tanks are pumped in a helium atmosphere and the exhaust is examined by a mass spectrometer leak detector capable of detecting one part of helium in 100,000 parts of normal air.

FACTORY RECONDITIONING of tanks, should it be necessary, is a relatively inexpensive process and relieves you of tank maintenance problems. The tank is reconditioned under the same controlled factory conditions described above and returned ready for more years of service. You can operate with a spare tank during reconditioning.

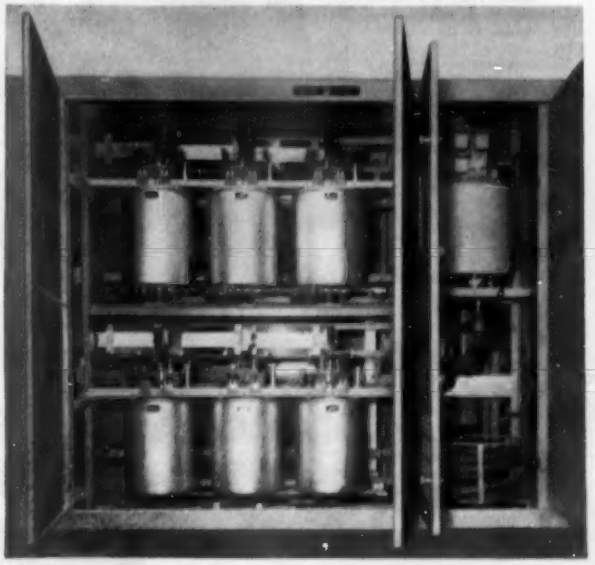
ADD TO THIS the highly efficient operation of mercury-arc conversion and you'll find that G-E pumpless rectifiers are the most economical way to get d-c power in the 750-kw range and above. For the whole story, contact your nearest G-E Apparatus Sales Representative or write for bulletin GEA-5689. General Electric Company, Schenectady 5, New York. 524-2

Progress Is Our Most Important Product

GENERAL ELECTRIC

ASSEMBLY ROOM for pumpless-rectifier tanks is clean, air-conditioned to help prevent contamination. After assembly, testing with mass spectrometer leak detector assures that tanks are free from even the most minute leaks.

LONG LIFE AND LOW MAINTENANCE are the payoff when these tanks are put into service. The six-tank rectifier compartment shown here is furnished with transformer and associated a-c and d-c switchgear—a completely metal-enclosed d-c substation which requires a minimum of floor space.



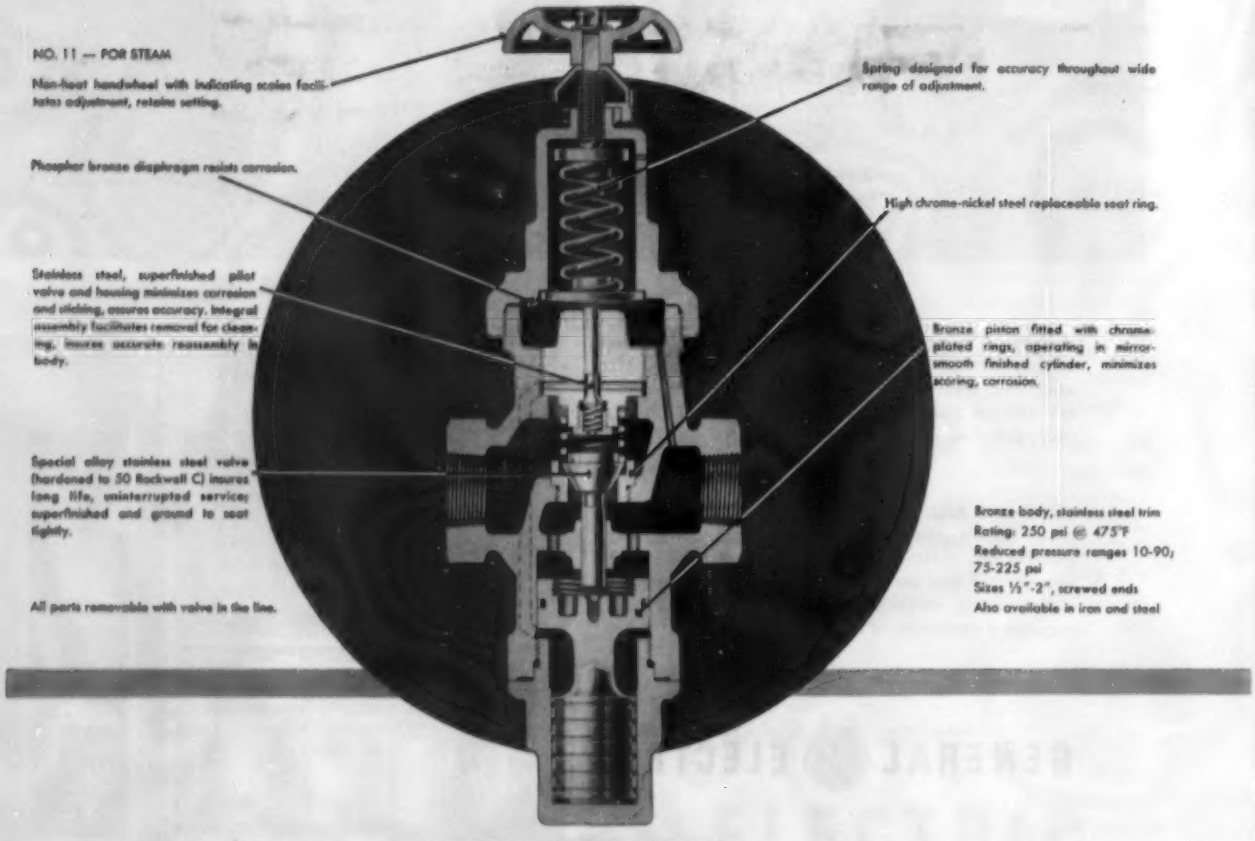
GENERAL ELECTRIC

MASONEILAN

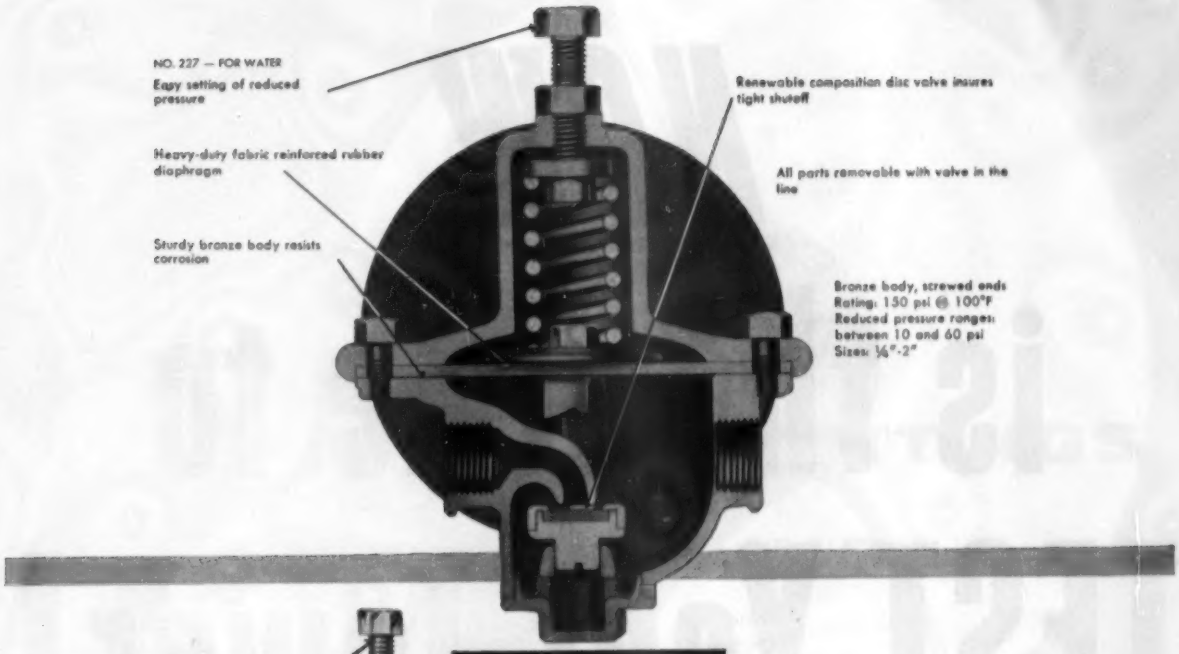
Some Quick Tips from Mason-Neilan on

SELECTING A PRESSURE REGULATOR

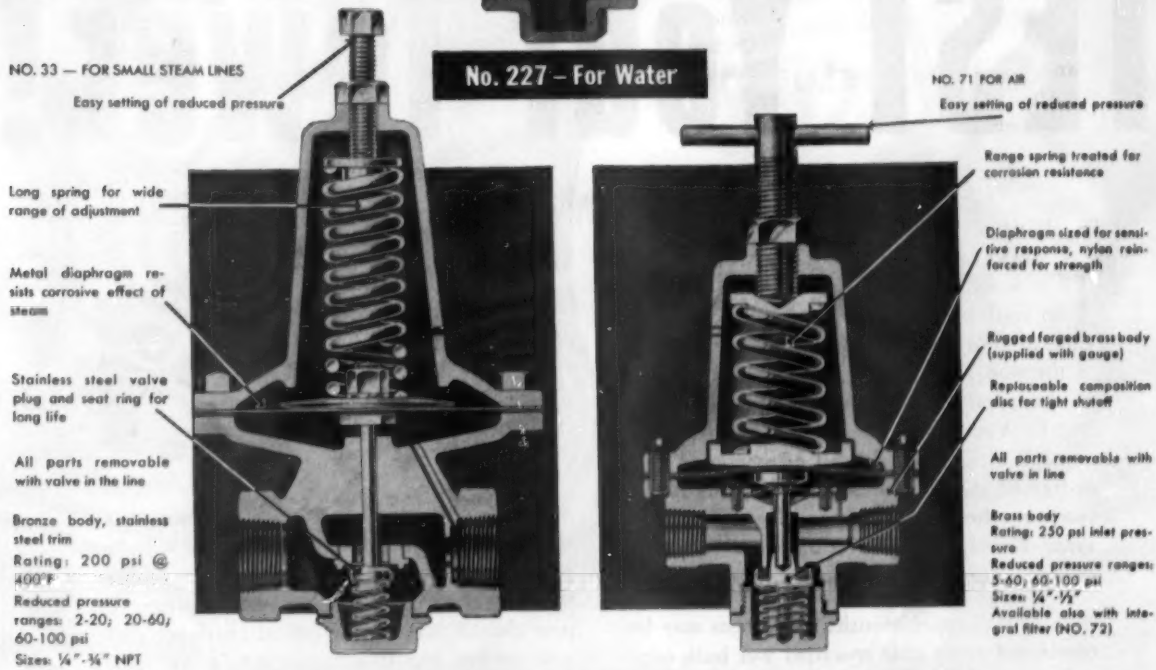
The best regulating valve for any specific application is the one that meets your accuracy requirements, fits the operating conditions, and gives you the lowest combination of maintenance and initial costs. Mason-Neilan engineers or your Mason-Neilan Distributor will be glad to discuss your problem, and help you to make this analysis. But here are some important features you should know and look for that will help you to make your own selection.


NO. 11 — FOR STEAM
Non-heat handwheel with indicating scales facilitates adjustment, retains setting.
Phosphor bronze diaphragm resists corrosion.
Stainless steel, superfinished pilot valve and housing minimizes corrosion and sticking, assures accuracy. Integral assembly facilitates removal for cleaning, insures accurate reassembly in body.
Special alloy stainless steel valve (hardened to 50 Rockwell C) insures long life, uninterrupted service; superfinished and ground to seat tightly.
All parts removable with valve in the line.
Spring designed for accuracy throughout wide range of adjustment.
High chrome-nickel steel replaceable seat ring.
Bronze piston fitted with chrome-plated rings, operating in mirror-smooth finished cylinder, minimizes scoring, corrosion.
Bronze body, stainless steel trim
Rating: 250 psi @ 475°F
Reduced pressure ranges 10-90; 75-225 psi
Sizes ½"-2", screwed ends
Also available in iron and steel

No. 11 – For Steam


NO. 227 — FOR WATER
Easy setting of reduced pressure
Heavy-duty fabric reinforced rubber diaphragm
Sturdy bronze body resists corrosion
Renewable composition disc valve insures tight shutoff
All parts removable with valve in the line
Bronze body, screwed ends
Rating: 150 psi @ 100°F
Reduced pressure ranges: between 10 and 60 psi
Sizes: ¼"-2"

No. 227 – For Water


NO. 33 — FOR SMALL STEAM LINES
Easy setting of reduced pressure
Long spring for wide range of adjustment
Metal diaphragm resists corrosive effect of steam
Stainless steel valve plug and seat ring for long life
All parts removable with valve in the line
Bronze body, stainless steel trim
Rating: 200 psi @ 400°F
Reduced pressure ranges: 2-20; 20-60; 60-100 psi
Sizes: ¼"-¾" NPT
NO. 71 FOR AIR
Easy setting of reduced pressure
Range spring treated for corrosion resistance
Diaphragm sized for sensitive response, nylon reinforced for strength
Rugged forged brass body (supplied with gauge)
Replaceable composition disc for tight shutoff
All parts removable with valve in line
Brass body
Rating: 250 psi inlet pressure
Reduced pressure ranges: 5-60, 60-100 psi
Sizes: ¼"-½"
Available also with integral filter (NO. 72)

No. 33 – For Small Steam Lines

No. 71 – For Air

ALL HIGH Quality Coefficient PRODUCTS

MASON-NEILAN REGULATOR CO.

1186 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia • Houston Pittsburgh • Atlanta • Cleveland • Cincinnati • Detroit • San Francisco • Boise • Louisville • Salt Lake City • El Paso Albuquerque • Odessa • Charlotte • Los Angeles • Corpus Christi • Denver • Appleton • Birmingham New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

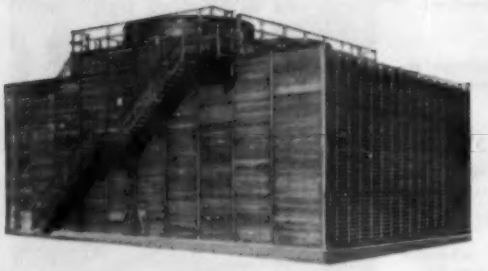
NOW

is the time to TEST Your Tower!

IF a water cooling tower has been installed in your plant in the past year, now is the time to find out whether the tower you own is the one you specified and paid for. This is the ideal time for a PERFORMANCE TEST. Your tower now should be operating at peak efficiency with all elements well co-ordinated. Of greater importance, ***this is the season when actual operating conditions most closely parallel conditions specified in your purchase contract.***

During summer months tower tests may be conducted at or near specified wet bulb temperatures, which means fewer variables, fewer calculations . . . it means the most accurate tests possible to obtain.

Since analysis of the results of a series of carefully conducted tests is the only method



of arriving at proof of the performance your tower is delivering, the manufacturer will be glad to assist in verifying the integrity of his product. He will welcome the opportunity to provide the necessary technical assistance that will enable you to conduct conclusive tests.

If you are not one of the 5000 engineers, operators and owners who requested copies of "Test Your Tower," the Marley brochure that explains a simple direct method of testing cooling towers, write for a copy today.

MARLEY

The Marley Company

Founder Member Cooling Tower Institute 222 West Gregory Blvd. Kansas City, Missouri

Question-Mark* FITTINGS

. . . A BARGAIN?

They could cost you your reputation!

***QUESTION-MARK FITTINGS**

Who is manufacturer?
How about his reputation?
What is his experience?
Does he give service?
Does he offer complete line?
Is stock available nearby?
Do fittings meet U. S. standards?
Are dimensions accurate?
Is circularity true?
Equal to strength of pipe?
Are fittings permanently marked with manufacturer's trademark and material designation?

YOU RUN THESE RISKS WITH THESE UNKNOWN PRODUCTS:

Failure in service . . . work stoppage . . . waste.
Impaired efficiency due to improper design.
Non-uniformity . . . wastes manhours.
Poor availability . . . costly in emergencies.
Short-line supply . . . handicaps selection.
Lack of service or responsibility.
Lack of engineering help on piping problems.
Lack of cost-cutting advancements.

Presented in the interests of piping safety and economy by

TUBE TURNS

A Division of National Cylinder Gas Company
LOUISVILLE 1, KENTUCKY

. . . Producer of **KNOWN VALUES**

Remember the trade-marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

How to safeguard your piping and get *more for your money*

When you buy TUBE-TURN* Welding Fittings and Flanges, you get these known values:

TOP QUALITY AND SAFETY **RESPONSIBILITY** **PRECISE UNIFORMITY**
ENGINEERING SERVICE **WIDE SELECTION** **LOWEST-COST PERFORMANCE**
PROMPT DELIVERY **DESIGN ADVANCEMENTS**

They are made in U.S.A. and are identified by the trade marks shown above.

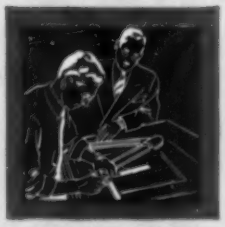
They meet ALL American Standard and Safety Code requirements.

They are engineered to give maximum strength and performance and in many cases exceed requirements by generous margins.

To get *more for your money* in welding fittings and flanges, specify the leading brand and buy from your trusted Tube Turns' Distributor.

Tube Turns' nearby complete stock SAVES YOUR PURCHASING TIME

Tube Turns' pioneering research GIVES YOU ADVANCED PRODUCTS



Tube Turns' engineering help GIVES YOU COST-CUTTING IDEAS

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

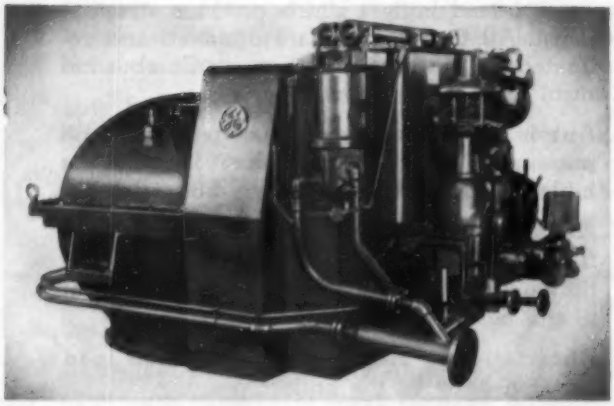
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
Los Angeles • San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TURBINES FOR
HIGH-SPEED COMPRESSORS

OIL DAM IN UPPER BEARING HALF, located at pencil point, restricts oil flow around shaft, building up a pressure pad as shown at left. As turbine gains speed, oil pressure increases and forces shaft down into ample surfaces of lower bearing liner, above right, assuring stability at high speed.

Large pressure-pad bearings add years of life to G-E high-speed turbines



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

To provide longer, more reliable service, all G-E high-speed turbines incorporate large pressure-pad bearings. The generous surfaces of the bearings assure low unit loading for ample lubrication and minimum wear during start-up.

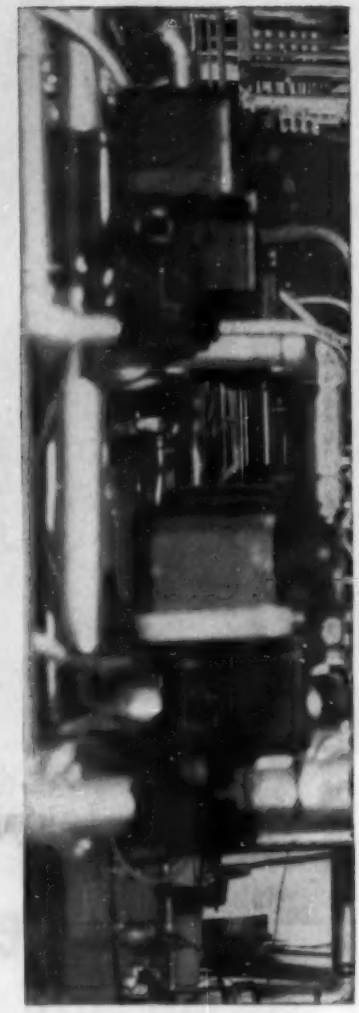
AS TURBINE SPEED INCREASES, the viscous pump action of the shaft carries oil into the cavity, forming a pressure pad. The shaft is thus forced into the lower bearing half, assuring high unit loading. This minimizes the possibility of vibration, with its detrimental effect on bearing and packing life.

THIS IS ONLY ONE OF MANY DESIGN FEATURES that make a G-E high-speed turbine your most reliable drive for compressors and blowers. For more information, contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company, Limited, Toronto. 241-1

Progress Is Our Most Important Product

GENERAL ELECTRIC

Anheuser-Busch's new Van Nuys, California, Budweiser brewery gets maximum boiler efficiency automatically with a complete Republic Combustion Control System centralized at this panel.



INDUSTRIAL POWER PLANTS *Can* OPERATE AT CENTRAL STATION EFFICIENCY

Time was when the industrial power plant was a series of "tea-kettle" boilers relegated to some dark corner of the manufacturing plant. Coal went in and steam came out—and the ratio between the input and output was thought to be something you couldn't do much about.

All of that is changed now. With today's high capacity, high efficiency industrial-sized boilers, new firing methods and automatic control systems, the modern industrial plant can produce steam with efficiency comparable to its big brother, the central station. In fact, lessons learned from central station operation are being used today to cut costs for many industrial power plants.

The power plant for Anheuser-Busch's new Budweiser brewery at Van Nuys, California is a good example. It has three 48,000 lbs./hr. gas or oil fired boilers which produce steam at 200 psi. All three boilers are operated and coordinated by a Republic Automatic Combustion Control System. This system:

1. Automatically maintains constant steam pressure by controlling the heat input to the boilers in accordance with the boiler load.
2. Automatically maintains maximum combustion efficiency by simultaneously and continuously controlling the fuel and air input to the boiler.
3. Automatically maintains any desired load division between the boilers.
4. Automatically maintains correct draft in each furnace.

REPUBLIC FLOW METERS CO.

In addition, a Republic two-element feed-water system which is tied into the combustion control system automatically adjusts the water supply to boiler requirements at all loads.

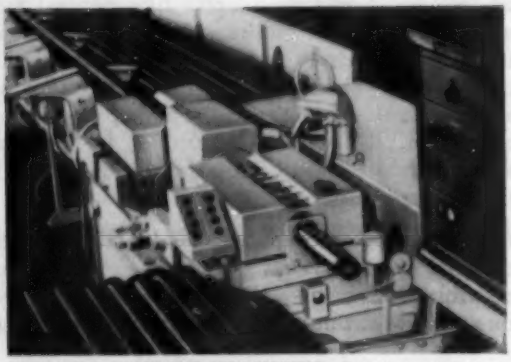
This Republic Combustion Control System at Budweiser, operates exactly like central station control systems. It makes actual measurements of the fuel and air it controls. Most important, the operation of all boiler auxiliaries is coordinated automatically for theoretically perfect boiler operation. If desired, individual boilers or the entire system can be operated manually from the control panel.

Anheuser-Busch actually gets more efficient operation in several ways through automatic control. Boilers are operated at optimum combustion conditions 24 hours a day, seven days a week. This assures lowest fuel cost per pound of steam produced. Fixed costs are also reduced since boilers are operated to deliver all of their rated capacity during "peak" loads. Extra stand-by equipment is not necessary. Finally, chain-of-event troubles that are caused by improper operation of auxiliaries is avoided by smooth, simultaneous adjustments made by the master control system.

Let Republic's combined experience in combustion control systems for both industrial plants and central stations help you operate your power plant more efficiently. No matter what size or type of boiler, load conditions, fuel firing or draft arrangement, Republic can design and produce a control system that will operate it for maximum efficiency—automatically. Write for full details.

2240 Diversey Parkway • Chicago 47, Illinois

QUALITY



FARROWTEST... EXCLUSIVE WITH REPUBLIC — This electronic tester is the most accurate non-destructive production testing equipment for tubing available today. Any flaw in the tube wall passing through the FARROWTESTER coils is registered by an oscillograph. In addition, the defect location is marked and the tube rejected.

...is much more than skin deep

Take an apple. It's a beauty. But if you peel it and find a worm hole, the beauty is stripped away just as surely as the peeling.

The old saying . . . "Beauty is more than skin deep" covers this situation. Further, if you take this saying and substitute "Quality" for "Beauty" you double its meaning. And considering the quality needed in boiler tubes to meet ever increasing pressures and temperatures, you can double the saying again. Allowable margin for error is practically zero.

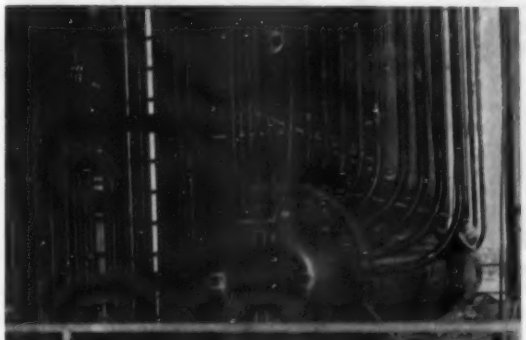
Quality has been the watchword in the manufacture of Republic ELECTRUNITE® Boiler Tubes, over the years. From raw ore to finished product, Republic exercises precise control over materials and methods. Then, completed ELECTRUNITE tubing is subjected to the most thorough testing program in the world. Of course this program includes the usual, and unusual, tests which take a sample and destroy it . . . to see what it can stand. But you can't put destroyed samples in service. What you need is a test that "gets under the skin" . . . so that you can be certain you receive the quality that was specified, and designed-in.

There is such a test today which Republic alone offers . . . an electronic test which shows up minute defects buried inside the tube walls. Its name . . . FARROWTEST® . . . developed by Republic to make certain that ELECTRUNITE tubing comes to you with the highest degree of perfection possible. You can specify this test on ELECTRUNITE Boiler Tubing instead of your present method, at no extra cost.

Millions of feet of FARROWTESTED ELECTRUNITE tubing are in service today in industrial, electric utility and marine boilers. Make sure you specify FARROWTEST on your next order for pressure tubing. Contact your Republic Steel and Tubes representative or mail the coupon for complete information. You'll be glad you did.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products



QUALITY IS MORE THAN SKIN DEEP . . . but the skin is important, too. ELECTRUNITE Boiler Tubes are absolutely uniform in diameter and, through "controlled atmosphere" normalizing, clean, fine-grained and scale-free. Installation in boiler drums is fast . . . roll-in and beading easy . . . "weepers" minimized.

REPUBLIC STEEL CORPORATION
3144 East 45th Street
Cleveland 27, Ohio

Please send me more details on

- ☐ ELECTRUNITE Boiler Tubes
- ☐ FARROWTEST

Name_____ Title_____

Company_____

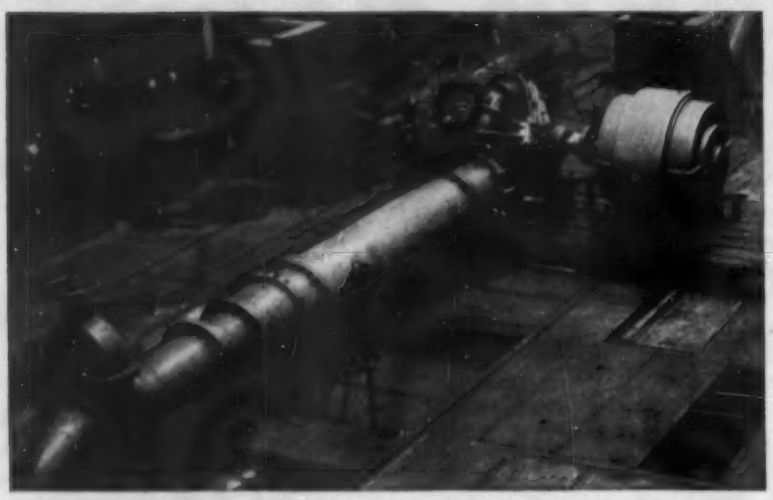
Address_____

City_____ Zone____ State_____

K-8015

Keep your eye on WORTHINGTON

Pump research primes pump progress



We have a lot of experience at Worthington—more than 114 years of it—and we're picking up more all the time.

But technology advances every day. Each step forward brings with it new and unsolved pumping problems. That's why Worthington's research and development program is continuous. That's also why we like to work with you during planning to get the jump on problems before they reach the costly stage.

Experts for every problem

For your day-to-day pumping problems, our sales engineers are thoroughly trained in pump applications in every field, and can usually supply the right answer fast. Naturally, for the really tough ones, our staff engineers back them up with all the equipment and facilities of our shops and laboratory. In addition, factory-trained troubleshooters are available to cope with any problem that may arise in the field.

From cat-cracker to atom-cracker

Our specialists, covering all major industries, work as a team. Together, they bring to bear on any problem a vast store of experience. They've successfully solved pumping problems and helped pioneer new developments in public works, atomic energy applications, the oil industry, and the chemical industry —to name a few.

So keep your eye on Worthington; we probably have a money-saving answer to your pumping problems. C-51

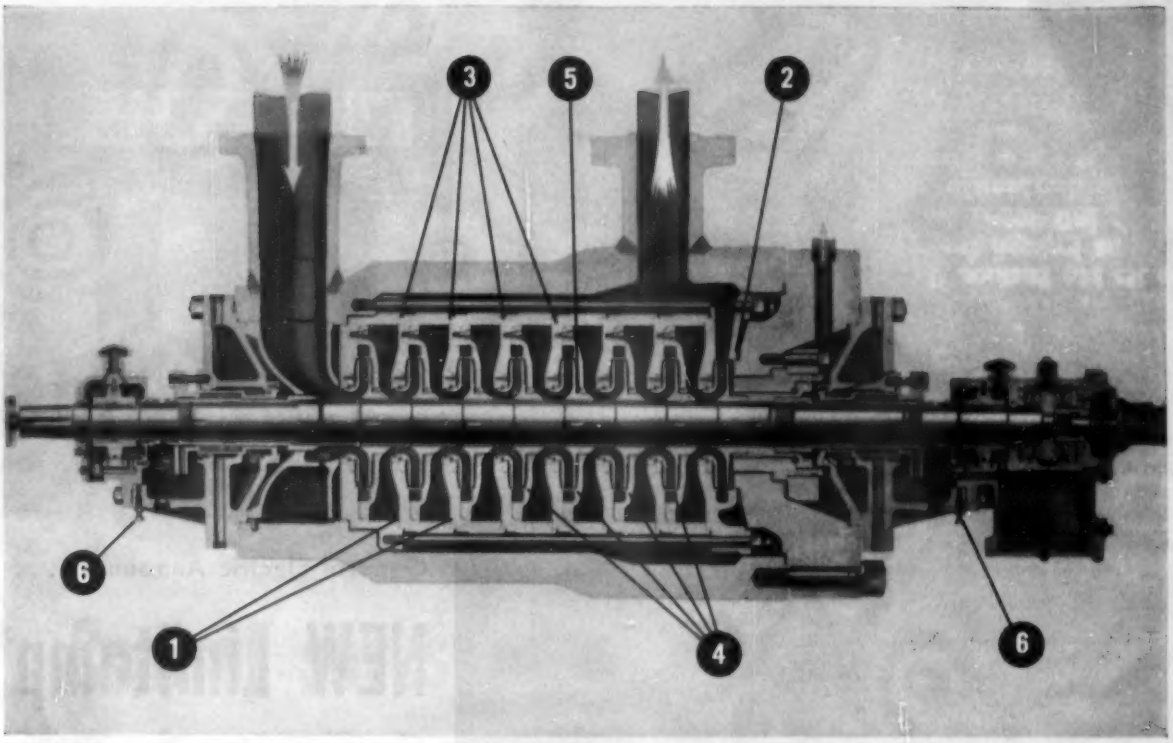
TEST STAND CAPACITY UP TO 100,000 GPM is provided at Worthington's Harrison plant *(above)*. Built over a man-made half-acre lake, the test stand is used as a production tool to check pumps from fractional horsepower up. This flexibility comes in handy—in one line alone Worthington can put together 60,000 different standard pumps out of 650 parts in six standardized sets of liquid ends.

DIRECTING PUMP TEST OPERATIONS from central control room *(left)* where special measuring instruments speed collection of performance data. Worthington pump specialists can afford to be objective in considering your pump application problem. They select from the most complete line of pumps offered by any manufacturer.

WORLD'S FIRST ATOMIC-POWERED SUBMARINE, *NAUTILUS*, undergoing sea trials. In atomic development since 1941, Worthington recently built special engine room equipment for both atomic submarines, *Nautilus* and *Sea Wolf*. Worthington continues to figure prominently in supplying this new field of atomic energy, keeping pace with its new and rapidly changing requirements.

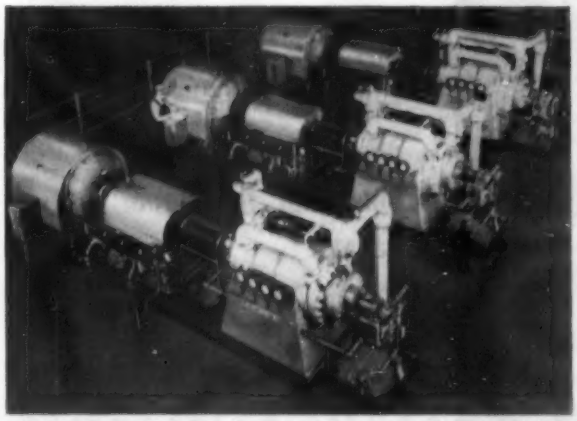
EUTECTIC CASTING, used in making standard Worthington pumps, frees engineer from casting restrictions. Formerly, design of impeller and diffuser blades had to allow hand withdrawal from fragile sand core. Eutectic casting uses a low-melting-point alloy to form blades, melting this alloy out during baking. This permits design flexibility for maximum hydraulic performance.

VITALITY OF WORTHINGTON RESEARCH PROGRAM is shown by the more than 300 articles in the technical press during the past five years by Worthington people. This flood of informative technical literature not only reflects our ability to keep pace with the changing hydraulic requirements for modern pumps, but also highlights the important contributions by Worthington to the knowledge of pumps.



WORTHINGTON high-pressure (over 1300 psi) boiler feed pump in cutaway view. Intake at left, discharge at right. Green areas show feed water path.

Look inside a Worthington high-pressure boiler feed pump



THREE WORTHINGTON six-inch, six-stage pumps, driven by 1250-hp motors through hydraulic couplings, feed boilers at Benning Station of Potomac Electric Power Company and help to provide power and light to homes and industry in the District of Columbia and portions of Maryland and Virginia.

They don't show on the outside, but here are seven basic features that are standard on Worthington high-pressure boiler feed pumps. They've been proved and improved over the 32 years since we pioneered the first high pressure centrifugal boiler feed pump. (Numbers are keyed to cutaway above):

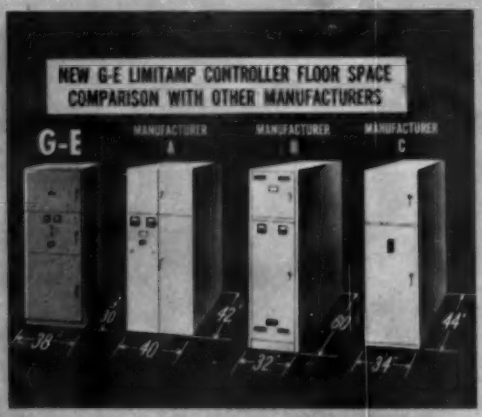
1. **ALL PRESSURE JOINTS** are metal-to-metal ring-type joints, the best construction for high-pressure service.
2. **INNER ASSEMBLY** firmly anchored at inboard end but free to expand with temperature changes and slide over centering fit in discharge head at outboard end.
3. **HYDRAULIC PRESSURE** acts to seal internal joints rather than open them.
4. **TWIN-VOLUTE** casing design has better hydraulic characteristics than common multiple vane diffusers while still eliminating radial thrust.
5. **ALL IMPELLERS** are shrunk on and keyed to shaft.
6. **VERNIER JACKSCREWS** at each end facilitate final adjustment of bearing centers.

Get the whole story on these high-pressure boiler feed pumps. Write for Bulletin W-319-B1D. Worthington Corporation, Harrison, New Jersey. C 5.1B

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE



356 SQ. IN. LESS area than next smallest starter.

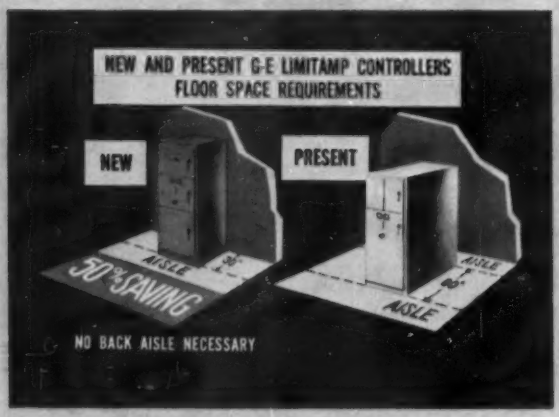
General Electric Announces . . .

NEW Limitamp*

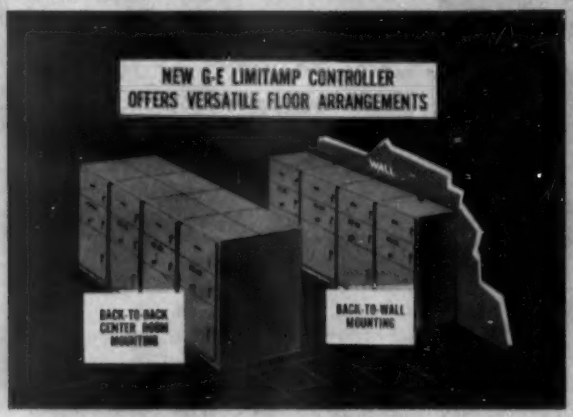
- **Gang-operated disconnect switch on all units**
- **Entirely front connected**
- **30-inch depth**
- **Low-voltage panel hinged to swing out of enclosure**
- **Contactor rolls in or out of cabinet**

NEW DESIGN

INSTALLATION IS SIMPLIFIED. A man can easily enter enclosure to make connections.



OVER 50% SPACE SAVINGS by elimination of back-aisle.



VERSATILE INSTALLATION—units all front connected.

Control saves over 50% floor space

ENTIRELY FRONT CONNECTED, only 30 inches deep, General Electric's all-new Limitamp control offers versatility of installation. New 30-inch depth allows unit to be transported through normal size doorways, and 90-inch height includes bus compartment. Back-to-back, back-to-wall, or mounting as free standing enclosure is now possible.

IDEAL FOR HIGH-VOLTAGE MOTORS, rated 2300-4800 volts and up to 3000 h-p, the new Limitamp control may be applied to squirrel-cage, synchronous, wound-rotor, and multi-speed motors on power systems requiring high interrupting capacity for maximum short-circuit protection.

NEW CONCEPTS IN SAFETY are built into new Limitamp control. Gang-operated disconnect switch, steel barriers between all compartments, enclosed bus compartment and co-ordination of starter assure you of safer high-voltage motor control.

G.E. LIMITAMP STARTERS are co-ordinated to provide maximum protection for equipment and personnel. Co-ordinated circuit components guard against needless fuse blowing, give running overload protection and provide maximum safe-guard against short-circuit damage for starter and equipment.

FOR COMPLETE APPLICATION ENGINEERING service contact your nearest G-E Apparatus Sales office. Write for Bulletin GEA-6331, Section 781-12, General Electric Co., Schenectady 5, New York.

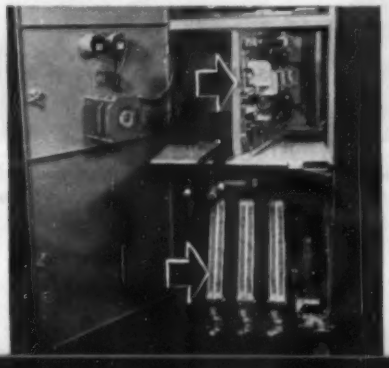
**Trade-mark of General Electric Company*

Progress Is Our Most Important Product

GENERAL ELECTRIC

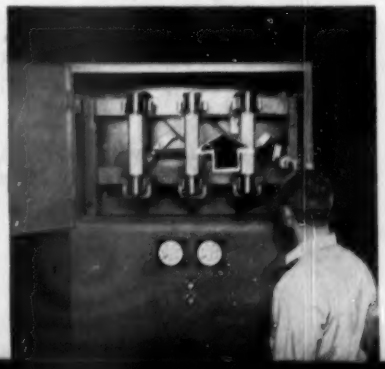
SIMPLIFIES INSTALLATION AND MAINTENANCE

MAINTENANCE IS EASY. Low-voltage panel swings out, contactor rolls out.



TYPE EJ-2 CURRENT-LIMITING fuses are safely, quickly replaced within seconds.

SAFE VISUAL CHECK of disconnect switch with fuse compartment door open.



How to spend less for expendables

Day after day, week after week, your instruments steadily use up charts, inks, thermocouple wires, tubes, wells—all the expendable accessories that require regular replacement.

If you've been buying your supplies on a hand-to-mouth basis, you're missing out on some sizable savings. Honeywell has developed a modern purchasing plan that gives you new economy, convenience, and quality. This new plan provides assistance in selecting the right supplies and sets up a custom-fitted schedule for buying that will cut your inventories, simplify your purchasing, and save you a big percentage of your annual bill.

New HSM Plan

Foundation of this new plan is your Honeywell Supplies Man. He is trained in the Honeywell factory and has a broad and thorough knowledge of instrumentation. A full-time supplies specialist, your HSM gives you personalized, expert service.

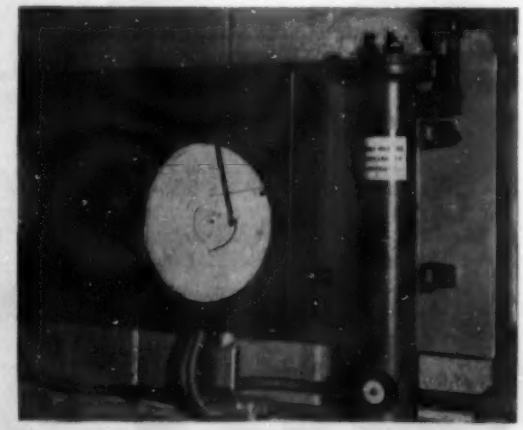
These men are strategically stationed throughout the country to serve you. They will help you plan your purchases to get maximum quantity discounts . . . keep your inventories balanced and always up to date.

Here's how the plan works

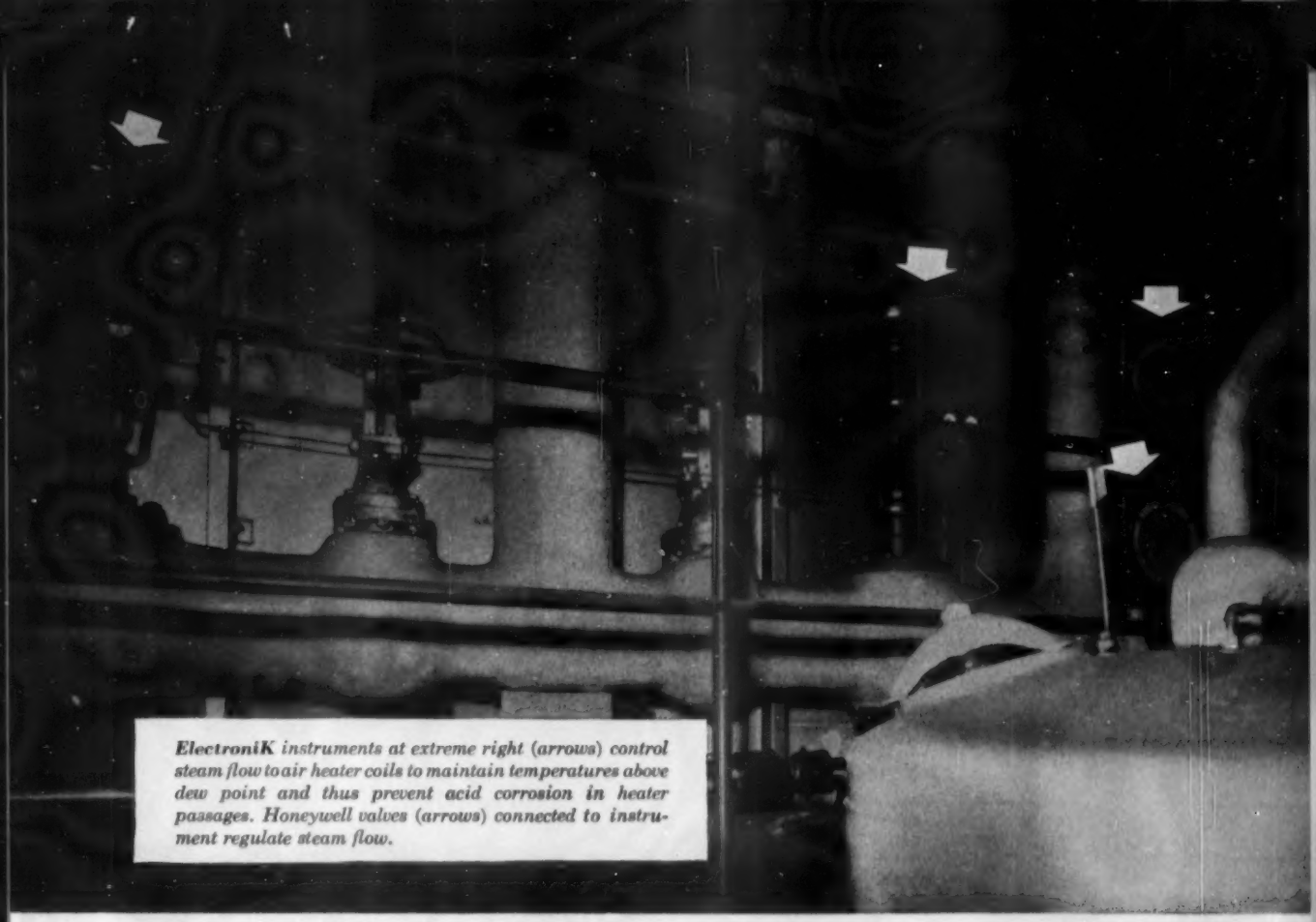
1. ***Survey plant***—Your Honeywell Supplies Man checks annual consumption of each supply item in your plant and establishes minimum inventory needs.
2. ***Detail requirements***—He then shows you what you can expect to purchase during the coming year to keep adequate stocks on your shelves.
3. ***Assist in selection***—He keeps you up to date on newest developments, and recommends specific types of equipment wherever your present buying can be improved.
4. ***Estimate savings***—Next, he prepares a blanket annual order, grouping like items to get the biggest quantity discount. Savings may run as high as 50%.
5. ***Schedule deliveries***—Finally, he arranges a regular delivery schedule that assures that you will always have adequate supplies on hand.

Give your Honeywell Supplies Man a call. He's at your local Honeywell office . . . as near as your phone.

Versatile Brown instrumentation—key to efficient control of critical



Evenly graduated flow meter, with its meter body mounted next to it, integrates and records flow of softened water to evaporators.



ElectroniK instruments at extreme right (arrows) control steam flow to air heater coils to maintain temperatures above dew point and thus prevent acid corrosion in heater passages. Honeywell valves (arrows) connected to instrument regulate steam flow.

variables in boiler rooms

WHEN YOU'RE planning new capacity or modernizing present installations, it will pay you to take a look at what Brown instrumentation can do in your boiler room. The two examples pictured here, at the Martin's Creek Station of Pennsylvania Power & Light, demonstrate just a few of the many applications where this modern line of precision equipment can be advantageously applied.

Anti-Corrosion Air Heater Control, a pair of *ElectroniK* potentiometers measure average cold end temperatures and regulate steam flow so as to maintain flue gas consistently above the dew point. This system prevents condensation and resulting sulfuric acid corrosion in the air heaters.

Guide for Efficient Operation for Feedwater, a Brown Flow Meter with evenly graduated scale records and integrates the flow of softened water to the evaporator to guide operators. The evenly graduated scale gives excellent readability across the entire chart. Fast electronic integration adds up total flow with exceptional accuracy.

Critical Variables—Also included in the Brown line are numerous other types of instruments for measuring, recording and controlling temperature, flow, conductivity, liquid level, pH and pressure . . . electric and pneumatic remote transmission systems . . . miniature *Tel-O-Set* instruments for graphic panel boards, and control valves. All are made to the highest standards of performance and dependability by the world's largest manufacturer of controls. All are backed by the nationwide facilities of the Honeywell service organization . . . ready to serve you promptly and effectively from offices close at hand.

Ask your local Honeywell sales engineer to discuss your particular plant control problems . . . he's as near as your phone.

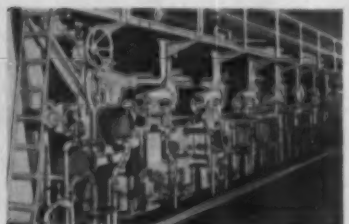
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for Catalog 2320, "Flow Meters"... and for Catalog 9050, "Instrumentation for Steam Plants."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

CELITE FILTRATION controls water purity— removes *all* suspended solids

In oil wells—output is boosted by repressurizing wells with water to force out accumulated oil. Celite Filtration purifies water to the extreme degree required—removes the minute suspended impurities which would otherwise clog the microscopic pores of sandstone.



In paper plants—Celite Filtration is used to purify the large quantities of water used in paper formation. Waste water may be filtered for reuse by the same process. Celite filter cakes can withstand many times the pressure of an ordinary filter bed. No pH control is necessary with Celite. ®T.M. Reg. U.S. Pat. Off.

CELITE® FILTRATION provides the *right degree* of purity that you require for industrial process water. It removes sediment which may cause costly downtime or damage to expensive plant equipment. And if your application requires greater purity, Celite removes even such fine suspended solids as amoebae and algae, many of which cannot be filtered out by other methods. Moreover, fast, economical rates of flow can be maintained with Celite Filtration

This selectivity in degree of water purity is made possible because Celite comes in nine standard grades . . . each designed to filter out impurities of specific size and type. Carefully processed from the purest deposits of diatomaceous earth, Celite always has utmost uniformity of product. Whenever you reorder, you are assured of the same accurately graded powder.

Celite Filtration offers many other advantages, too. Important space savings are achieved in the installation, longer filtration cycles are obtained, and less backwash water is required for cleaning the filters than with ordinary systems.

Celite Filtration provides pure process water for boiler make-up, heat exchangers, circulating water for towers . . . and many other industrial uses. It will pay you to investigate the advantages of Celite for your particular application. To have a Celite engineer study your problem and offer recommendations, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

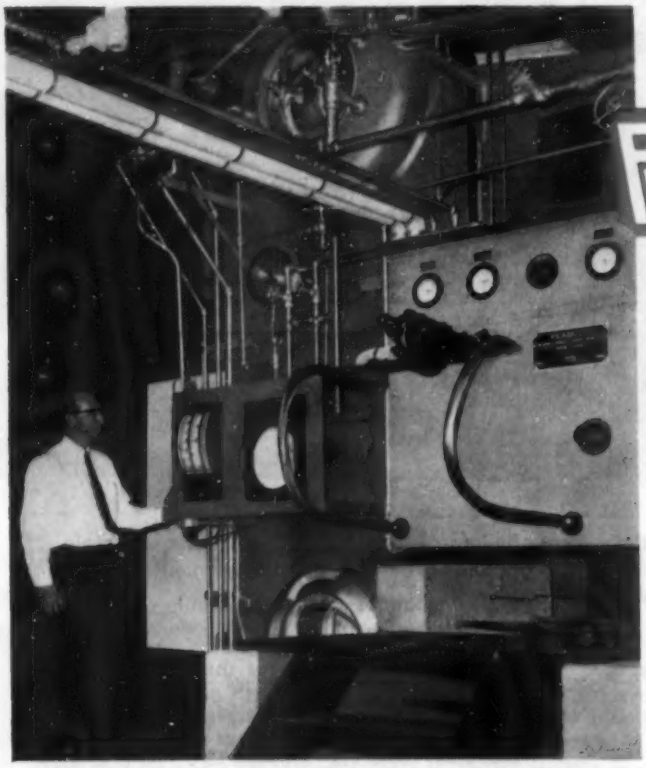
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE FILTER AIDS

HOTEL SYRACUSE

SYRACUSE, NEW YORK

CUTS STEAM COSTS by $13,680 per year



Chief Engineer John Reschke of Hotel Syracuse makes routine inspection of new FW Packaged Steam Generator. This single unit, in continuous year-around service, supplies all steam requirements for the Hotel's 600 rooms, 4 restaurants, 3 kitchens, 13 stores, lobby, grand ballroom and laundry PLUS the heating and processing requirements of an adjacent hotel!

with this new

packaged steam generator

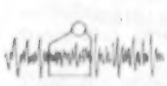
Central New York's largest hostelry, the 600-room Hotel Syracuse, recently replaced two of their original coal-burning boilers with a Foster Wheeler 25,000 lb/hr Packaged Steam Generator.

According to Chief Engineer John Reschke, the advantages of the new unit were immediately apparent. Steam cost dropped from 90 cents to 71 cents per 1,000 lb. Based on average consumption of about 72,000,000 lb per year, this represents an annual saving of $13,680 in steam costs alone. Other advantages are rapid steaming, lower maintenance and a cooler boiler room.

• • •

For low-cost steam "where you need it—when you need it," you get a better buy with the Foster Wheeler Package Steam Generator. For more detailed information, write for *new* catalog, PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

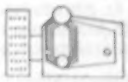
LOOK INTO THESE FW FEATURES:



RAPID LOAD SWINGS. Large diameter drums and ample heating surface.

HIGH STEAM TEMPERATURES. Provisions for high superheat.

ADAPTABILITY. Easily moved. Require only a slab foundation—permit outdoor installation.



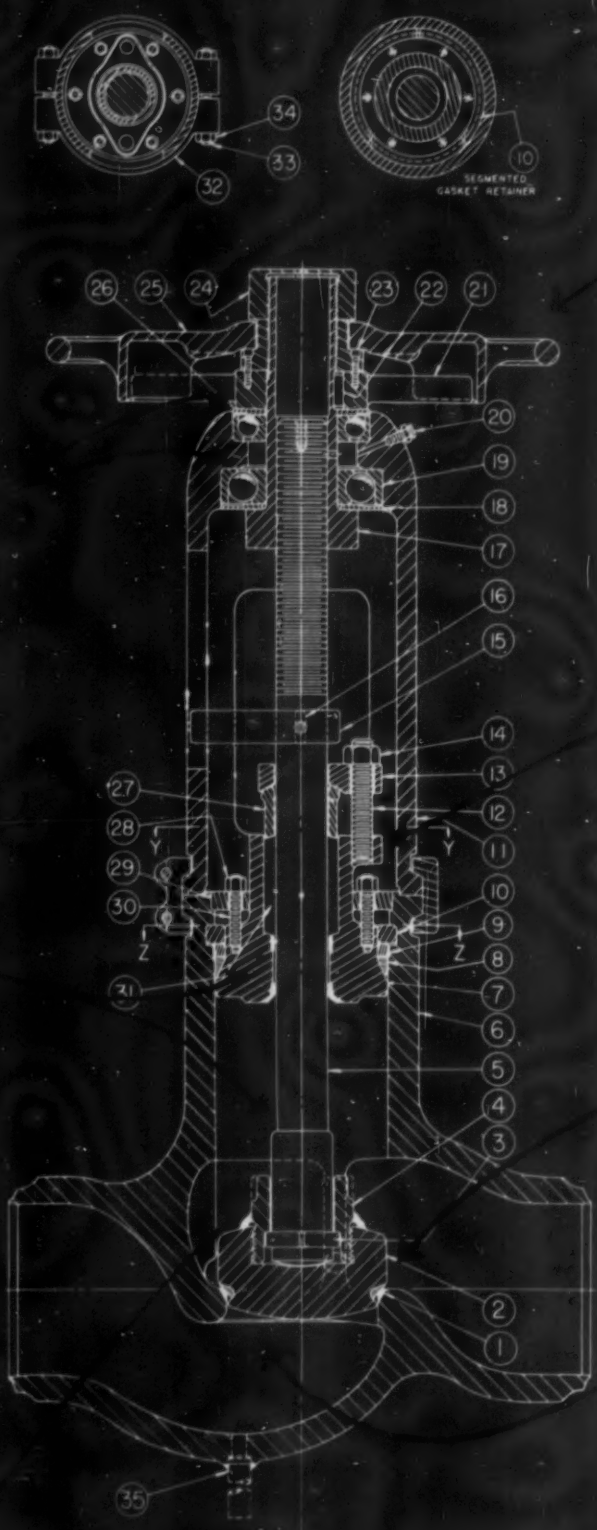
ECONOMIZERS. Package economizers available to increase capacity and minimize fuel cost.

ACCESSIBILITY. For inspection, cleaning and maintenance.

COOLER OPERATION. Maximum water-cooled surface, special insulation mean cooler boiler room.

FOSTER WHEELER

D.C.H.—
Note comments.
These features
are worth money
to us! C.R.B.



ROCKWELL BUILT *Edward Valves*

LIST OF MATERIALS

QUANTITIES ARE FOR ONE VALVE

WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED, THE LATEST REVISION APPLIES

PIECE NO	NAME OF PIECE	NO REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS NO
1	SEAT	1	INTEGRAL WITH BODY	STELLITED	481
2	DISK	1	FORGED ALLOY STEEL WITH STELLITED SEATING FACE	A.S.T.M. A182, GRADE F11 WITH C 0.12% MAX-CR 1 1/4%-MO 1/2%	227 481
3	STEM COLLAR	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
4	DISK NUT	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
5	STEM	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
6	BODY		CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
			CAST STEEL C-0.20% MAX	A.S.T.M. A217, GRADE WC6	226
			CAST STEEL C-0.18% MAX	A.S.T.M. A217, GRADE WC9	242
7	BONNET	1	CAST STEEL C-0.25% MAX	A.S.T.M. A217, GRADE WCI	209
8	PRESSURE SEAL GASKET	1	ARMCO IRON - 90 BHN MAX	MALLEABLE PLATED	506
9	SPACER RING	1	STEEL		
10	GASKET RETAINER	1	EVALLOY	A.S.T.M. A182, GRADE F6	212
11	YOKE	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
12	GLAND STUDS	2	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
13	GLAND FLANGE	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
14	GLAND BOLT NUTS	2	STEEL	A.S.T.M. A194, CLASS 1 OR 2	124
15	STEM GUIDE COLLAR	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
16	STEM GUIDE KEY	1	STEEL	S.A.E. 1020	
	YOKE BUSHING	1	CAST BRONZE	A.S.T.M. B-148 GRADE 9B-HT	432
18	BEARING WASHER	1	STEEL-EVALIZED	A.S.T.M. A212, GRADE B	115
19	ANGULAR CONTACT BALL BEARINGS			S.A.E. STANDARD	
20	ALEMITE FITTING	1	BUTTON-HEAD INDUSTRIAL TYPE		
21	CROSSARM	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
22	CROSSARM KEY	1	STEEL	S.A.E. 1020	
23	HANDWHEEL BUSHING	1	BRASS	A.S.T.M. B62	412
24	HANDWHEEL LOCKNUT	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
25	IMPACTOR HANDWHEEL	1	CAST IRON	A.S.T.M. A126, CLASS A	301
26	BEARING WASHER	1	STEEL-EVALIZED	A.S.T.M. A212, GRADE B	115
27	GLAND	1	STEEL	A.S.T.M. A105, GRADE II	111
28	BONNET RETAINER NUTS	6	STEEL	A.S.T.M. A194, CLASS 2H	127
29	BONNET RETAINER RING	1	STEEL PLATE	A.S.T.M. A212, GRADE B	115
30	BONNET RETAINER STUDS	6	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
31	PACKING RINGS		HIGH TEMPERATURE PACKING		
32	YOKE LOCK RING	1	CAST STEEL C-0.30% MAX	A.S.T.M. A216, GRADE WCB	102
33	YOKE RING STUDS	4	ALLOY STEEL	A.S.T.M. A193, GRADE B7	208
34	YOKE RING STUD NUTS	8	STEEL	A.S.T.M. A194, CLASS 2	127
35	DRAIN NIPPLE	1	CHROME MOLYBDENUM	SCHED. 160 PIPE	229

EDWARD VALVES, INC.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

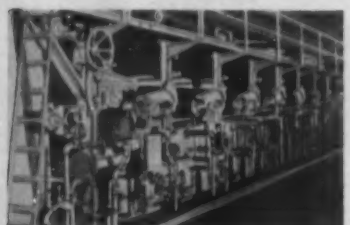
EDWARD GLOBE STOP VALVE
PRESSURE SEAL BONNET — WELDING ENDS
GENERAL ASSEMBLY

DRAWN [illegible]		DRAWING NO.
CHK'D [illegible]		AE-3297-5
APP'D [illegible]	DATE:	

Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

CELITE FILTRATION controls water purity— removes *all* suspended solids

In oil wells—output is boosted by repressurizing wells with water to force out accumulated oil. Celite Filtration purifies water to the extreme degree required—removes the minute suspended impurities which would otherwise clog the microscopic pores of sandstone.



In paper plants—Celite Filtration is used to purify the large quantities of water used in paper formation. Waste water may be filtered for reuse by the same process. Celite filter cakes can withstand many times the pressure of an ordinary filter bed. No pH control is necessary with Celite. *T.M. Reg. U.S. Pat. Off.

CELITE* FILTRATION provides the *right degree* of purity that you require for industrial process water. It removes sediment which may cause costly downtime or damage to expensive plant equipment. And if your application requires greater purity, Celite removes even such fine suspended solids as amoebae and algae, many of which cannot be filtered out by other methods. Moreover, fast, economical rates of flow can be maintained with Celite Filtration

This selectivity in degree of water purity is made possible because Celite comes in nine standard grades . . . each designed to filter out impurities of specific size and type. Carefully processed from the purest deposits of diatomaceous earth, Celite always has utmost uniformity of product. Whenever you reorder, you are assured of the same accurately graded powder.

Celite Filtration offers many other advantages, too. Important space savings are achieved in the installation, longer filtration cycles are obtained, and less backwash water is required for cleaning the filters than with ordinary systems.

Celite Filtration provides pure process water for boiler make-up, heat exchangers, circulating water for towers . . . and many other industrial uses. It will pay you to investigate the advantages of Celite for your particular application. To have a Celite engineer study your problem and offer recommendations, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

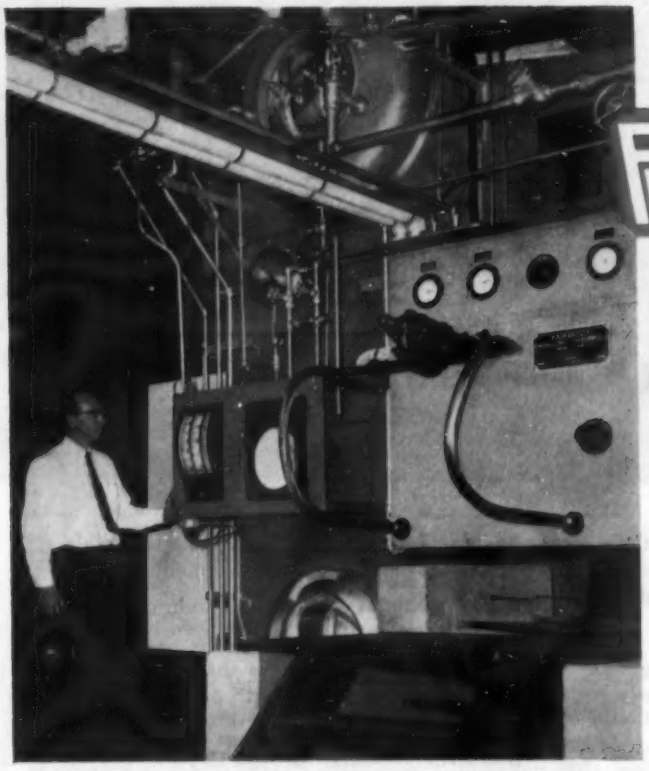
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE FILTER AIDS

HOTEL SYRACUSE

SYRACUSE, NEW YORK

CUTS STEAM COSTS by $13,680 per year



Chief Engineer John Reschke of Hotel Syracuse makes routine inspection of new FW Packaged Steam Generator. This single unit, in continuous year-around service, supplies all steam requirements for the Hotel's 600 rooms, 4 restaurants, 3 kitchens, 13 stores, lobby, grand ballroom and laundry PLUS the heating and processing requirements of an adjacent hotel!

with this new

packaged steam generator

Central New York's largest hostelry, the 600-room Hotel Syracuse, recently replaced two of their original coal-burning boilers with a Foster Wheeler 25,000 lb/hr Packaged Steam Generator.

According to Chief Engineer John Reschke, the advantages of the new unit were immediately apparent. Steam cost dropped from 90 cents to 71 cents per 1,000 lb. Based on average consumption of about 72,000,000 lb per year, this represents an annual saving of $13,680 in steam costs alone. Other advantages are rapid steaming, lower maintenance and a cooler boiler room.

• • •

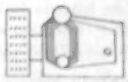
For low-cost steam "where you need it—when you need it," you get a better buy with the Foster Wheeler Package Steam Generator. For more detailed information, write for *new* catalog, PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

LOOK INTO THESE FW FEATURES:

RAPID LOAD SWINGS. Large diameter drums and ample heating surface.

HIGH STEAM TEMPERATURES. Provisions for high superheat.

ADAPTABILITY. Easily moved. Require only a slab foundation—permit outdoor installation.



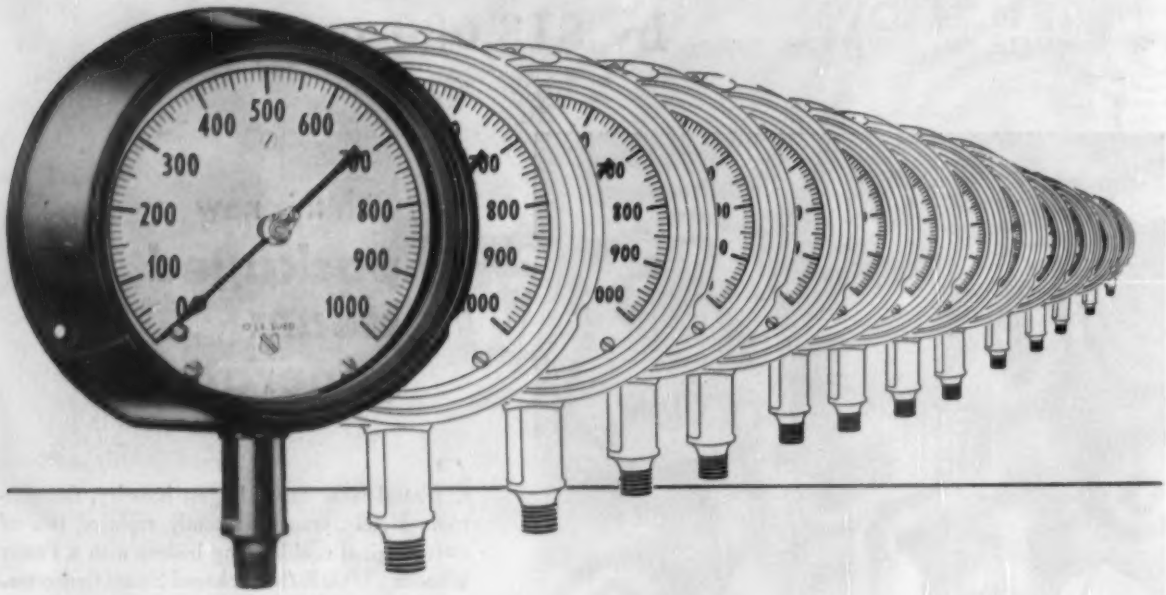
ECONOMIZERS. Package economizers available to increase capacity and minimize fuel cost.

ACCESSIBILITY. For inspection, cleaning and maintenance.

COOLER OPERATION. Maximum water-cooled surface, special insulation mean cooler boiler room.

FOSTER WHEELER

SATISFACTION MULTIPLIED
3 x 8 x 8 x 38 x 2 x 5



Service Conditions primarily determine the pressure gauge you specify for your installation. The wrong gauge can cost time, trouble, and money.

That's the big reason why Ashcroft Duragauges make sure of your complete satisfaction by offering a multiple choice in case designs and materials, Bourdon tube materials, ranges, movements, and dial sizes. Briefly, you can select the right gauge for your requirements from:

Cases of 3 different materials in 8 service-proved designs.

Bourdon Tubes of 8 different types of metals to meet specific service requirements.

Pressure Ranges from 30" vacuum or a few ounces through 100,000 psi.

Rotary Geared Movements that include the famous "Nylon Movement" or all stainless steel.

Dial Sizes from 4½" through 12".

Most important, Ashcroft Duragauges provide that unbeatable combination of highest sustained accuracy and durability of any pressure gauge built.

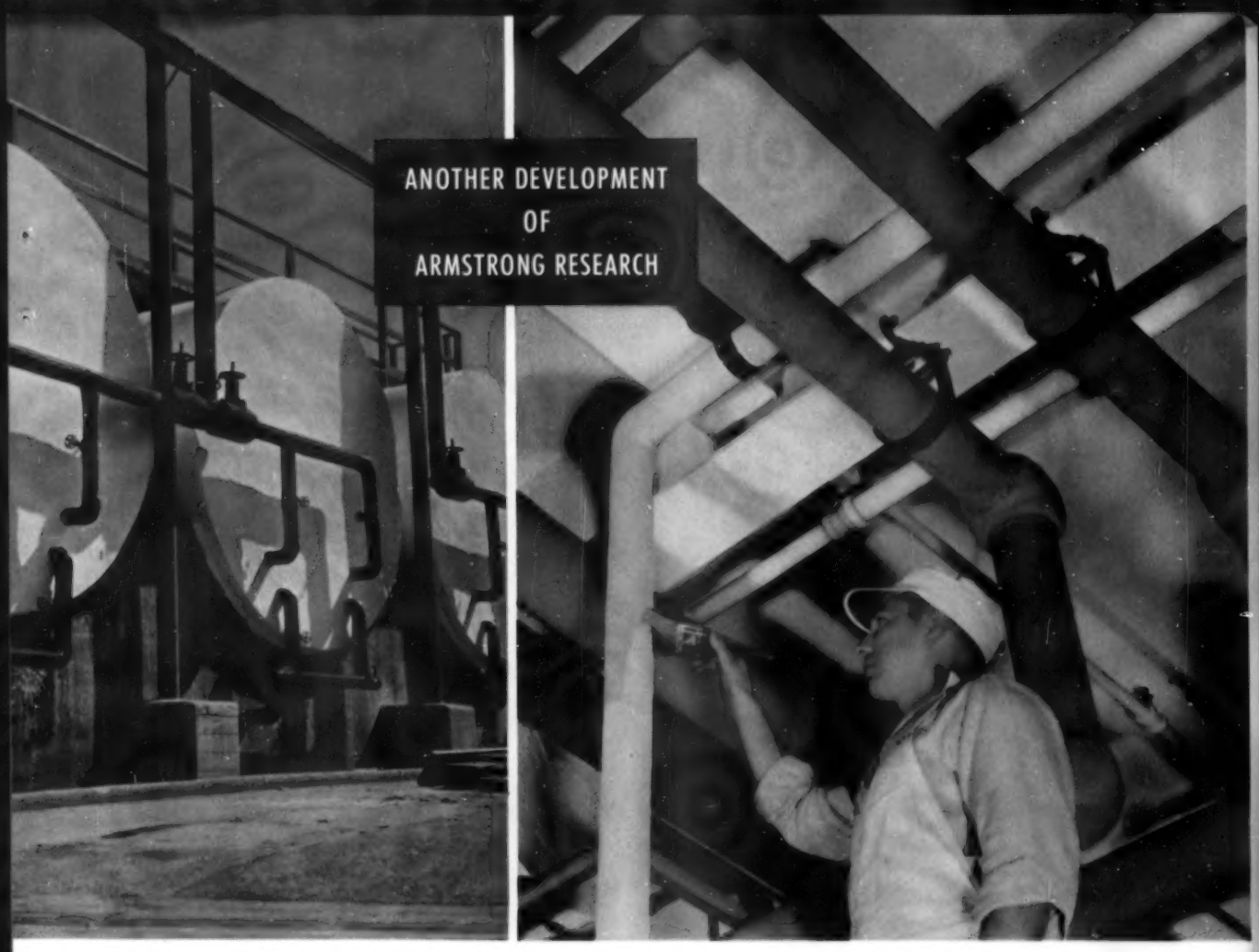
TAKE ADVANTAGE of the counsel of your nearby Industrial Supply Distributor. You can count on him to help you select Ashcroft Duragauges that will serve better and longer, with minimum maintenance, no matter how severe the conditions of vibration, pulsation, corrosion and weather.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



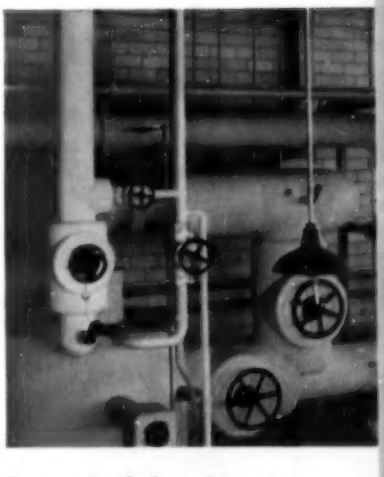
Insulcolor . . . *tough plastic finish protects and color codes insulated lines and tanks*

On both indoor and outdoor installations, you can be sure of long-lasting protection with this rugged insulation finish. And the durable plastic Insulcolor® coating not only protects insulated lines, tanks, vessels, ducts, and cold rooms, but serves as color identification, too.

Available in a choice of seven colors and white, Insulcolor furnishes a smooth, good-looking finish. It will withstand a wide range of temperatures and severe outdoor conditions without cracking, crazing, or peeling. Bumping or abrasion will not damage Insulcolor's tough plastic surface, and Armstrong Insulcolor is both fire resistant and moisture resistant, too.

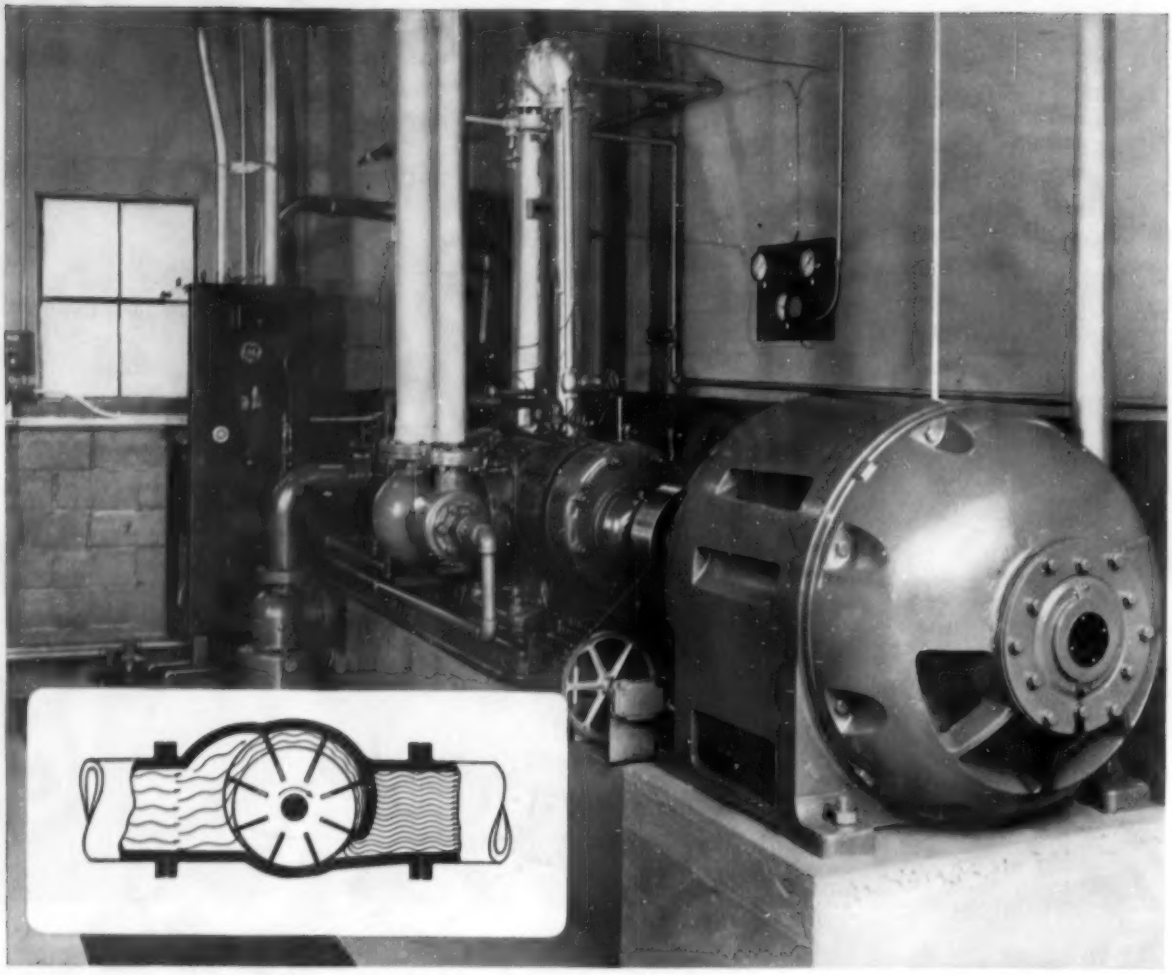
Insulcolor is quickly and easily applied by brush or spray gun. An application lasts many years with little or no maintenance. Dirt, grease, and soot are readily washed off the smooth Insulcolor surface.

One of many products developed by Armstrong Research for the industrial insulation field, Insulcolor is readily available through the Armstrong Contract Service. Get full details on Insulcolor and the Armstrong Contract Service from your nearest Armstrong office. For your copy of the free 32-page booklet, "Armstrong Industrial Insulations," write today to Armstrong Cork Company, 209 Stratton Street, Lancaster, Pennsylvania.



Because Insulcolor color codes, as well as protects, it eliminates the bother and expense of stenciling or painting insulated lines with an identifying color after the finish has been applied.

Armstrong INDUSTRIAL INSULATIONS



TWICE THE CAPACITY

of a Comparable Duplex Horizontal-belted Reciprocating Compressor

The Fuller Rotary serves best when you require additional compressed air, and available space for a compressor is limited.

It has twice the capacity of a comparable duplex horizontal-belted reciprocating unit, is singularly lacking in vibration, and requires only a nominal foundation to support its weight.

Operating at normal speeds, the Fuller Rotary Compressor is direct-connected and needs no cumbersome reduction gearing or belts. You can put a Fuller Rotary in almost any unused corner, or on a balcony, or (in reasonable size) even suspend it from the rafters.

Normal industrial pressure to 125 psig; capacities to 3300 cfm. Detailed information on design characteristics and typical space-saving applications will be forwarded on request.

Fuller

. . . . pioneers in harnessing AIR

FULLER COMPANY, Catasauqua, Pa.

GENERAL AMERICAN TRANSPORTATION CORPORATION SUBSIDIARY

Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C-270
1555

Allis-Chalmers Supplementary Treatment

Eliminates All Scale!

WATER SOFTENING PLANTS SELDOM REMOVE all scale-forming material. In fact, only one part per million of hardness in feedwater will amount to twenty pounds of scale or sludge after twenty million pounds of steam is generated. In even a short period, this build-up can cause serious trouble. In addition, condensate is frequently contaminated.

To solve this problem, Allis-Chalmers has developed its supplementary treatments, which are formulated specifically to the requirements of individual plants.

You can find out about factors involved in designing the proper supplementary treatment in Allis-Chalmers Water Conditioning Informational Bulletin 52. It explains how Allis-Chalmers water conditioning engineers approach this problem. Get a copy from your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

A-4594

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT,
SERVICE—FOR OVER 25 YEARS

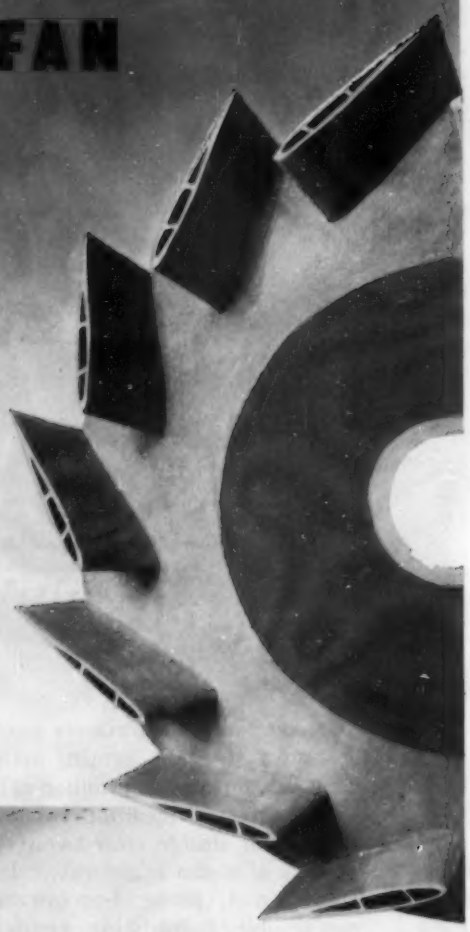
GREEN
POWER AND PROCESS PLANT EQUIPMENT

AIRFOIL TYPE DRAFT FAN

M *ast*

E *fficient*

P *oint* of Six Designs ranges from 80-84 static efficiency



Those of you who have known GREEN for many years know that our ratings have always been conservative. You won't get less; often you get more.

With our *modernized* line of AIRFOIL Type Fans — we're calling them the GALEX Fans—we are following the same policy. Results—both test and operating—indicate our GALEX Fans will produce consistently high efficiencies. Static efficiencies are noted above. Mechanical efficiencies range from 84-88%. But with so many variables both in fan design and in operating conditions, buyers prefer the conservative ratings.

To this line of modernized, streamlined draft fans of the AIRFOIL Type, Green engineers bring more than 48 years of experience in designing and manufacturing draft fans. Actually, this AIRFOIL Type of Fan is nothing new to us. We made them in this country during the World War I era and many of those old AIRFOIL Type Fans are still in service. Today, some 35 years later, much more is known about fans and their behavior. Today, Green Fans are in an even stronger position to meet the requirements of the modern power plant.

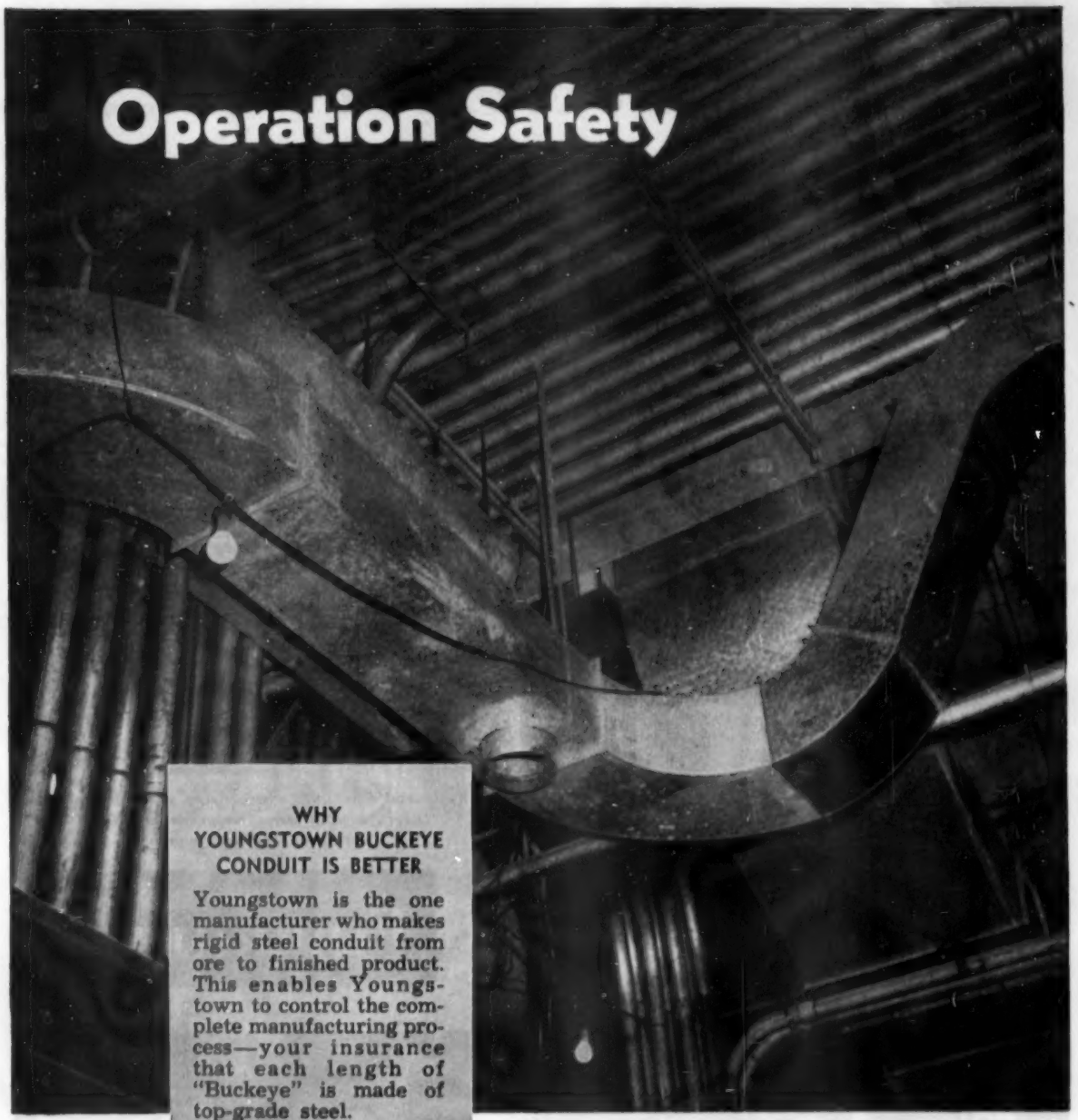
We'll be glad to discuss your fan requirements with you and see which of the six AIRFOIL Designs would be best. With six designs, many combinations of volume and pressure are available.

GREEN THE AIRFOIL TYPE FAN Galex FAN

GREEN FUEL ECONOMIZER COMPANY, Inc.

BEACON 3, NEW YORK

Operation Safety



WHY YOUNGSTOWN BUCKEYE CONDUIT IS BETTER

Youngstown is the one manufacturer who makes rigid steel conduit from ore to finished product. This enables Youngstown to control the complete manufacturing process—your insurance that each length of "Buckeye" is made of top-grade steel.

Youngstown

QUALITY YOUNGSTOWN SERVICE

●Youngstown Buckeye Rigid Steel Conduit is the safe raceway. It is approved by the National Electrical Code for all hazardous locations. In addition it is safe and sure to work with—easy to bend, and erect. Enamel does not chip. Thus Buckeye provides a smooth, continuous raceway for fast, trouble-free running or withdrawal of wires.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Youngstown, Ohio - Export Office: 500 Fifth Avenue, New York 36, N. Y.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES

stability...

just one of many reasons why KAYLO® is the king of high temperature insulations

Other high temperature insulations may look like Kaylo—but performance brings out the difference. Take stability, for instance.

Even when soaked in water for long periods, or immersed in boiling water, Kaylo (hydrous calcium silicate) not only refuses to break down but, after drying out, shows no apparent shrinking or warping! And its original thermal efficiency and exceptional strength return, too! Moreover, it can be removed and replaced for line inspection without waste.

No wonder Kaylo is called "king of high temperature insulations!"

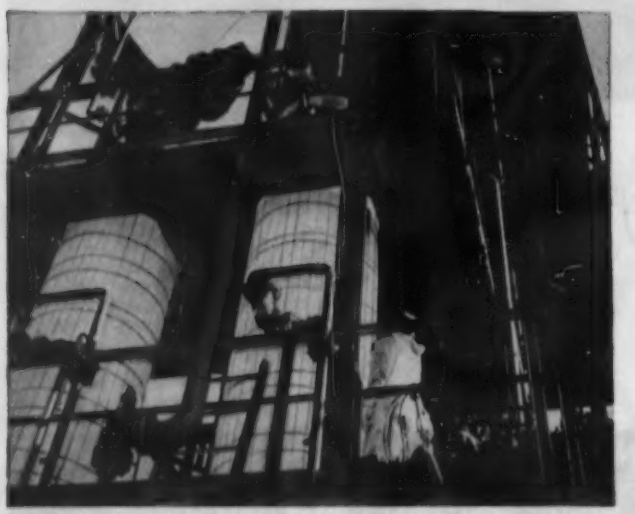
Together with Fiberglas®—the world's leading industrial insulation—Kaylo rounds out the most complete and versatile line of plant insulations available. It is distributed by Owens-Corning Fiberglas Corporation, and is made both as block and molded pipe insulation with the widest range of sizes, forms and thicknesses of any high temperature insulation.

For complete technical data, see our listings in Sweet's File, Chemical Engineering Catalog, or Refinery Catalog. Or write: Owens-Corning Fiberglas Corp., Dept. 186-H, Toledo 1, Ohio.

Kaylo and Fiberglas now provide you with complete coverage from lowest sub-zero to 1200° F—from one reliable supplier.

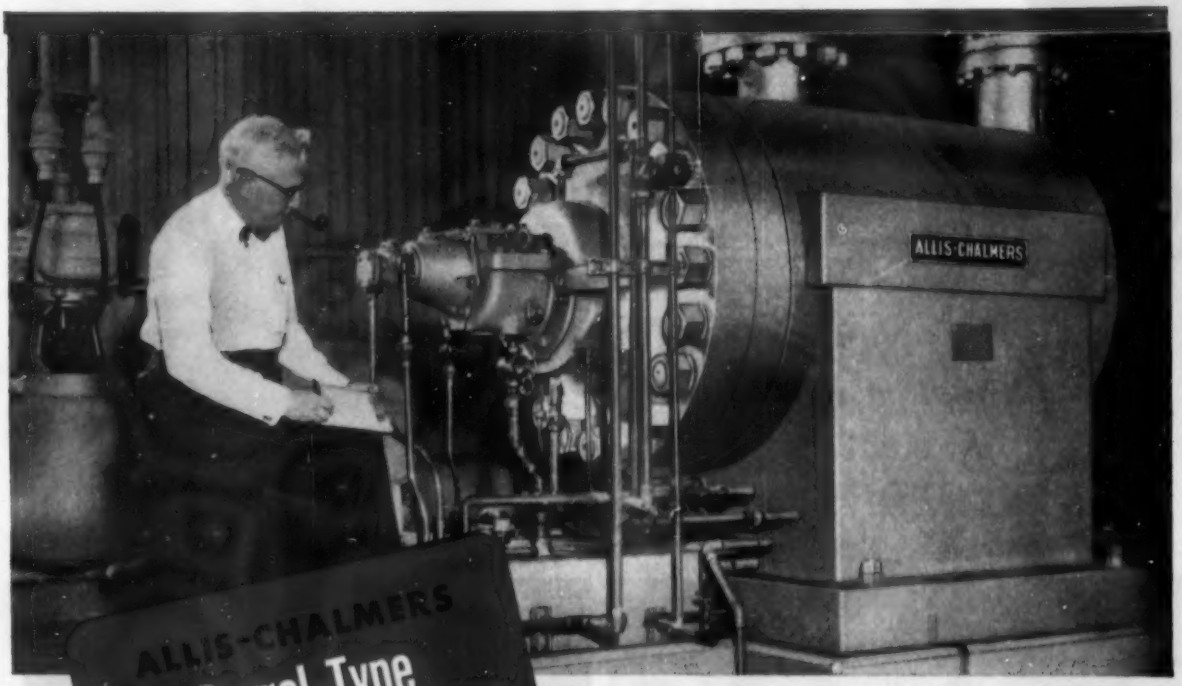
OWENS-CORNING
FIBERGLAS

® T. M. Reg. Owens-Corning Fiberglas Corporation
® Kaylo is mfd. by Owens-Illinois Glass Co., Inc.



Kaylo on a pair of "strippers" in a fractionating plant, one of an increasing variety of industrial applications.

Kaylo block on desalter tank. Strength of material and large units mean more economical application, less waste.



ALLIS-CHALMERS
Barrel-Type
BOILER FEED PUMPS

In the Dallas Steam Electric Station

OF THE DALLAS POWER & LIGHT COMPANY

What Are Your Pump Needs?

Whether you require boiler feed, condensate, circulating or other power plant pumps — a careful study will reveal why more and more utilities are specifying Allis-Chalmers. Check the design features, the operating advantages, the provisions that make a pump easier to maintain, or service. You, too, will find it pays to standardize on Allis-Chalmers Power Plant Pumps.

Complete Unit from One Source

Allis-Chalmers can supply the complete pumping unit—pump, motor and control—of coordinated design and manufacture. You get one responsibility—one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 08B7899.

Here Are Important Features that Keep Operating Costs Low:

- First stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads.
- Impellers, mounted back to back, balance axial forces without use of balancing drum.
- Double volute casing maintains radial balance under fluctuating load.
- Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

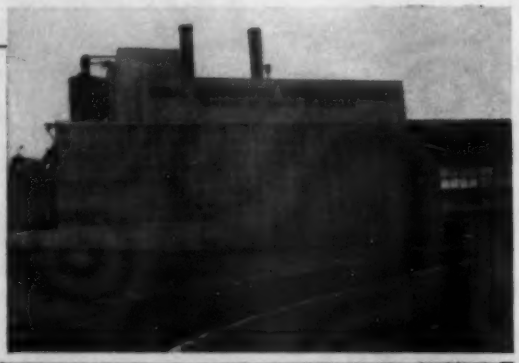
A-4790

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Another Norton Rx *on the job!*

Power plant remedies inadequate boiler protection by switching to CRYSTOLON armor blocks*



Walls of water tube boilers were trouble spots in the modern plant of the Rural Cooperative Power Association in Elk River, Minnesota. This photo shows how the previously used refractory material broke down, after comparatively short service, under chemical attack by accumulated fly ash. Results of this inadequate refractory protection were inefficient heat transfer, low-capacity boiler operation and costly shut-downs for repairs. Compare this picture with the one at the right, taken at the same plant.

CRYSTOLON armor blocks provided the Rx. Photographed a year after installation, these rugged silicon carbide refractories look like new. Withstanding the attacks of fly ash, and enabling easy removal of slag, they reduce maintenance and downtime. And because of their high thermal conductivity they transmit heat uniformly to the boiler tubes — still another example of how Norton CRYSTOLON refractories provide maximum protection plus conduction.

Norton CRYSTOLON refractories, *engineered and prescribed* for better boiler performance, are characterized by exceptional hot strength, high refractoriness and thermal conductivity. They withstand the mechanical and chemical attacks of a wide variety of fuels and have great resistance to slag penetration, spalling and abrasion.

Get further facts on how these or other Norton refractories can supply money-saving Rx's for your own boiler operations. Ask your Norton Representative for a copy of *Refractories for Heat and Power*. Or write to NORTON COMPANY, 447 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
REFRACTORIES
Engineered...Rx...Prescribed
Making better products...
to make your products better

Guaranteed TO SHUT TIGHT*

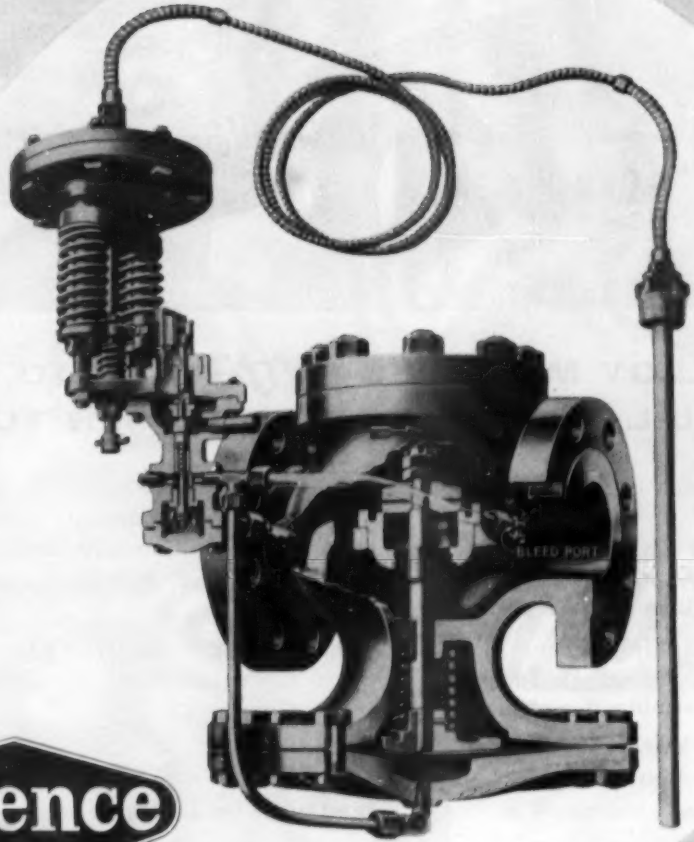
* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

ON THE NOSE

PRECISE ALLOY MIX GIVES *extra life* TO CHASE® ANTIMONIAL ADMIRALTY CONDENSER TUBES

Strange that such a simple little thing as weighing could add years of life to a condenser tube. Yet this careful weighing, plus extra care in manufacture, is the reason why Chase Antimonial Admiralty Condenser Tubes *do* last longer!

Thanks to this weighing process, Chase Antimonial Admiralty Condenser Tubes contain *exactly* the right combination of metals to resist the ravages of dezincification. As a result, Chase Antimonial Admiralty Condenser Tubes mean lower operating costs, fewer breakdowns, more time between tube replacements!

Prove it yourself! Next time you plan a new installation, or replace condenser tubes, install Chase Antimonial Admiralty—and enjoy extra years of service!

Prompt Delivery from Cleveland and Waterbury Mills

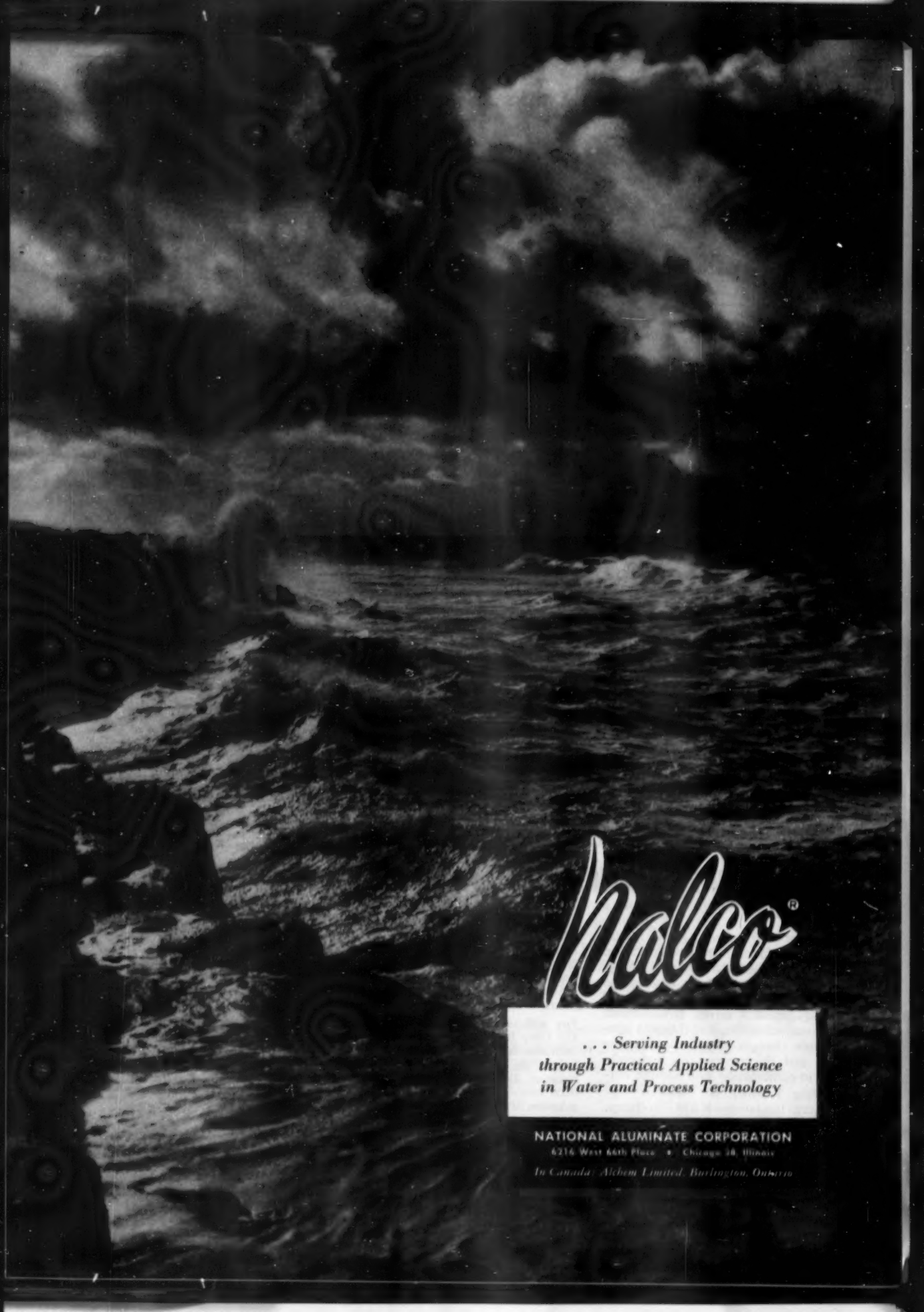
Chase®

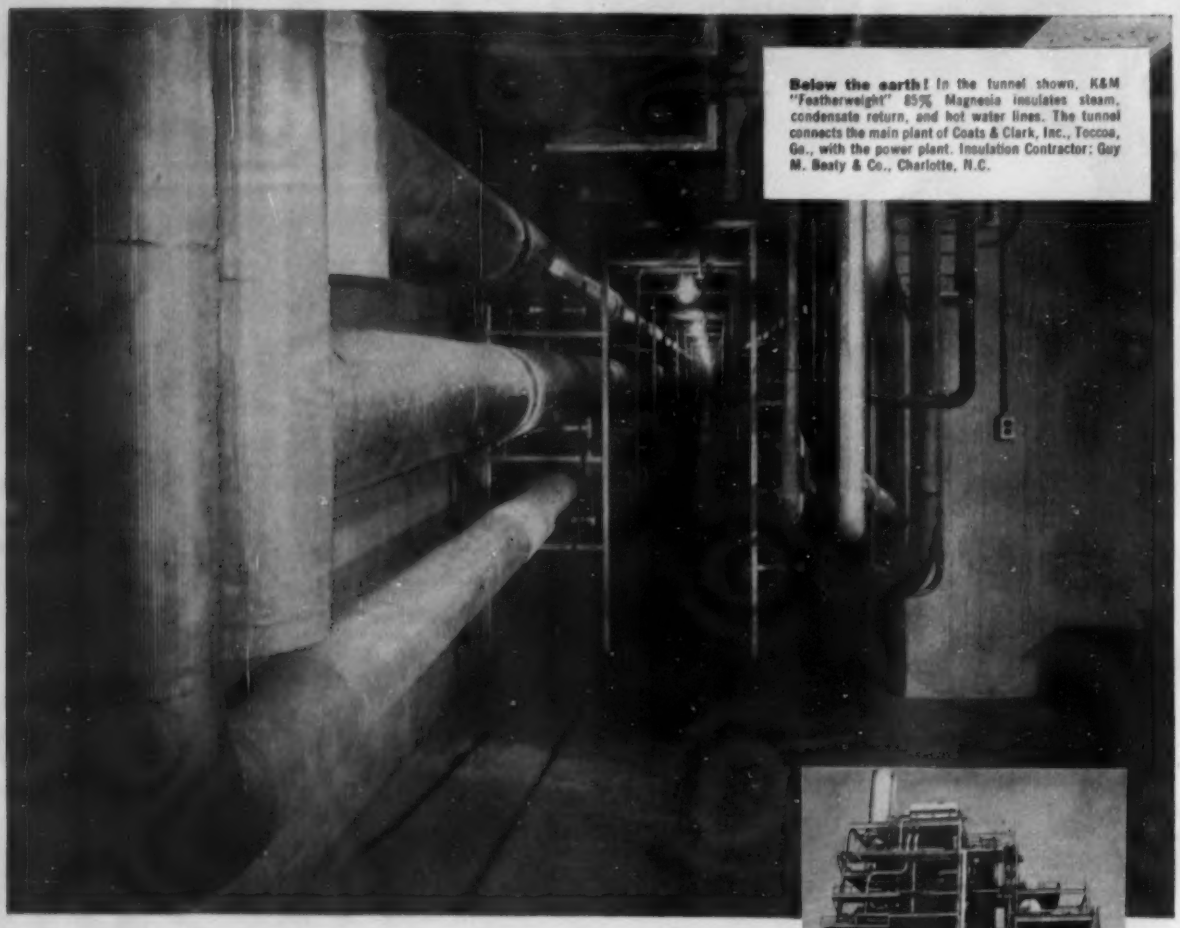
BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

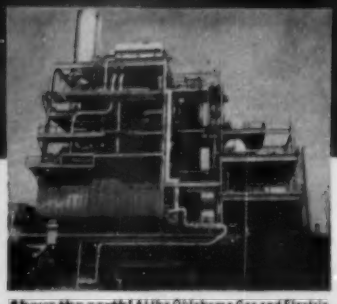
The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Detroit	Los Angeles	New York	St. Louis
Atlanta	Cincinnati	Grand Rapids†	Milwaukee	Philadelphia	San Francisco
Baltimore	Cleveland	Houston	Minneapolis	Pittsburgh	Seattle
Boston	Dallas	Indianapolis	Newark	Providence	Waterbury
Charlotte†	Denver	Kansas City, Mo.	New Orleans	Rochester†	(Sales office only)


halco®
. . . Serving Industry
through Practical Applied Science
in Water and Process Technology
NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario



Below the earth! In the tunnel shown, K&M "Featherweight" 85% Magnesia insulates steam, condensate return, and hot water lines. The tunnel connects the main plant of Coats & Clark, Inc., Toccoa, Ga., with the power plant. Insulation Contractor: Guy M. Beaty & Co., Charlotte, N.C.



Above the earth! At the Oklahoma Gas and Electric Company's plant in Sulphur, Oklahoma, K&M "Featherweight" 85% Magnesia insulates equipment exposed to the elements.

Underground or far aloft— K&M high pressure insulations save dollars by saving heat!

Wherever they're used, K&M insulations give efficient, heat-saving service. K&M "Featherweight"® 85% Magnesia—used on the steam lines in the tunnel shown above—lasts the life of the equipment it serves. It withstands moisture, vibration, and frequent temperature changes. Supplied in various sizes and thicknesses, it's frequently used in combination with another outstanding Keasbey & Mattison high pressure insulation—K&M Hy-Temp.

These materials, when used together, and applied so that joints are staggered, eliminate the heat loss that normally occurs in single-layer installations—particularly when expansion causes joints to open.

For efficiency to 1900°F. — K&M Hy-Temp Insulation. Usually applied in combination with K&M "Featherweight" 85% Magnesia. This material is made of diatomaceous silica combined with heat-resistant mineral fillers and asbestos fiber.

For efficiency to 600°F. — K & M "Featherweight" 85% Magnesia. 85% of this insulation is composed of basic carbonate of magnesia, the remainder of asbestos fiber.

Where severe water exposure may damage insulation, or where high humidity and moisture are present, K&M "Featherweight" Water-Resistant Magnesia is especially effective. It withstands temperatures to 450°F.

All K&M high pressure materials assure you dependable, economical insulation —be sure to keep them in mind! For additional data—and the name of your K&M distributor, who is also an experienced applicator—write directly to us.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos®

In Canada: Atlas Asbestos Company, Limited, Montreal, Toronto, Winnipeg and Vancouver

NOW! An Entirely New Method For Sizing Controls!

BS&B's New, Exclusive Method Takes Both The GUESS And The WORK Out Of Controls Sizing For Liquid, Steam And Gas Applications!

Today's modern and complex processing systems require accurate control valve sizing. No one has recognized this fact more than BS&B.

Therefore, as a service to industry, BS&B set out to develop a new, simple, more accurate method of sizing controls. Here it is in the new BS&B Controls Sizing Manual.

This new, exclusive method uses two new "tools" to make sizing more accurate—the SIZE-O-GRAPH to determine what the valve MUST do and Cv RATINGS to determine what the valve WILL do.

These "tools" are based upon thousands of hydraulic flow tests performed on all sizes and types of BS&B Controls in the industry's largest and most modern flow testing laboratory. Results are proven by correlation with *actual* gas and steam flow tests.

If you'd like a copy of this new manual, write to . . .

OVER 60 YEARS — BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q8
7500 East 12th Street, Kansas City 26, Missouri

Evenly matched or not...

there's enough difference to make all the difference

Before the bout, two fighters may look equally good to the fans. After a round or two, the differences begin to show up.

It's the same with heat exchanger tubes. They all start out looking pretty much alike, but under the test of day-in, day-out operation, Scovill Phosphorized Admiralty Heat Exchanger Tubes have consistently shown superior performance.

Hot-extrusion from Scovill Continuous-Cast billets means uniformity in the metal, uniformity of chemical composition and grain structure, uniformly high phosphorus content. It means sounder metal—smooth, dense, free from pits or porosity. These—plus Scovill's unrivaled Technical Application Services—are, indeed, differences that make *all* the difference in economical, uninterrupted service under tough operating conditions. Let us tell you more about them.

Scovill Manufacturing Company, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

SCOVILL **HEAT EXCHANGER TUBE**

Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Muntz Metal • Naval Brass • Red Brass, 85% • Deoxidized Copper Arsenical Copper • Copper Nickel, 10% & 20% • Cupro Nickel, 30% • Aluminum Brass • Aluminum Bronze, 5% • Duplex Tube

SSCSB

(Advertisement)

HALL LABORATORIES, INC.—A SUBSIDIARY OF HAGAN CORPORATION, PITTSBURGH, PENNSYLVANIA

Hall Industrial Water Report

VOLUME 3 AUGUST 1955 NUMBER 4

It Takes a Lot of Water Conditioning To Operate a Steel Mill at Capacity Plus

The constantly increasing production of steel demands a constantly increasing stream of raw materials. Water, used in many ways, is one of the most important. More than 100 tons of water go into the production of every ton of steel, underlining the importance of water engineering to the steel industry. Hall Laboratories, through close cooperation with plant personnel, serves the steel industry, whether in routine control of daily treatment, or in solving the many special problems peculiar to the steel industry.

The Skid-Pipes Were Skidding

Difficulties with cooling water constitute the bulk of steel plant water problems. For example, in one steel plant, the water cooled skid-pipes on which billets are pushed through 2000°F reheating furnaces were buckling.

Investigation revealed that scale formation cut down heat transfer and caused the overheated pipes to fail. Threshold Treatment of the cooling water with Calgon® now keeps the skid-pipes free of scale, and the buckling of the pipes is no longer a problem.

Discoloration of Galvanized Strip Checked

Hall engineer B. Q. Welder reports on solution of a problem in the galvanizing mill of a large steel mill in the "Iron City."

"Galvanized strip unaccountably developed large dark discolorations some weeks after shipment. It seemed to me that the source of the discoloration might be in the rinsing operation.

"Following galvanizing, the strip was rinsed by immersion in and spraying with filtered river water. The last step in the process was a chromate-silicate rinse prepared with clarified river water. Carryout of solids from the rinses was responsible for the trouble.

"Since adopting our recommendation that condensate be used for the rinse following the immersion tank and in making up the final chromate-silicate rinse there have been no further reports of trouble."

Baffling Problem Solved

When the exchange capacity of a sodium zeolite softener in an eastern steel mill dropped to 8.2 kilograins per cubic foot from a rated capacity of 16 kilograins per cubic foot, plant personnel consulted their Hall engineer, D. E. Noll. To confirm his suspicion that hydraulic channeling of the resin bed was responsible for the loss of capacity, Noll tried an intermediate backwash to redistribute the resin. The backwash doubled the length of the run, indicating that channeling might be the trouble.

When operation permitted an inspection of the resin bed, Noll and the plant men found that although fissures had not broken through, high flow rates around the edges of the unit had pushed down the exchange material, and a cone had formed in the bed.

To step up the efficiency of the softeners, Noll suggested a baffle design that would insure even distribution of the incoming water throughout the exchange bed. When the units were returned to service with baffles installed, the exchange capacity came up to the rated 16 kilograins per cubic foot and normal regeneration practice was resumed.

Specialists in iron and steel metallurgy are skilled at transforming crude ore into finished metal. Like the technologists in steel, Hall Laboratories fits the treatment of a vital raw material, water, to the need in specific processes in the manufacture of steel.

New Control System Tested

A new system of automatic blowdown control developed by Hall Laboratories' research has shown in field trials that it maintains boiler water solids concentration within plus or minus 5% of the set point.

The equipment continuously determines the dissolved solids concentration in boiler water by measuring the conductivity of a flowing sample. A signal from the conductivity cell pneumatically controls the blowdown valve.

The new control system minimizes the possibility of carryover and allows close control of treatment under all conditions.

Booklet H-1, describing the Hagan Automatic Blowdown Control System, is available upon request.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Laboratories, Inc.—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

Get Both bearing features

fully enclosed and protected

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

. . . yet easy to grease

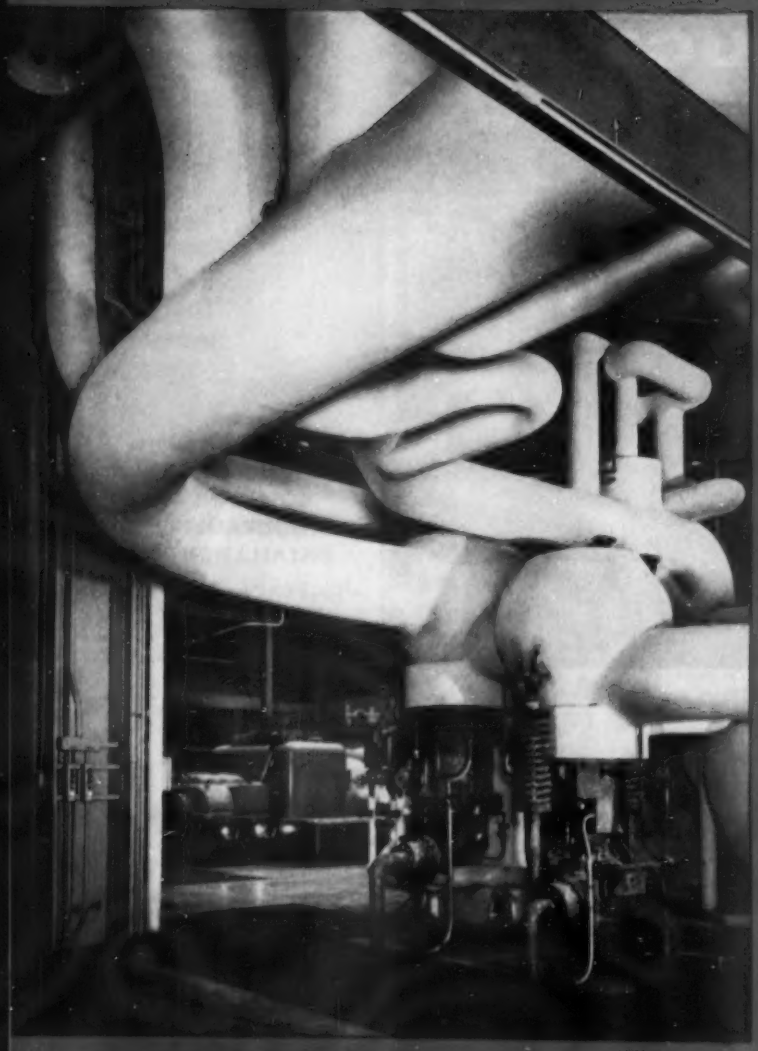
You can lubricate the bearings without dismantling the motor. Pipe-tapped holes in the bearing housings at three points provide both means for inserting new grease and a means of flushing out old grease.

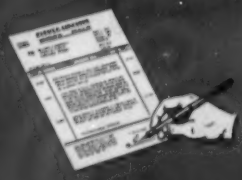
Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7225.

A-4609

ALLIS-CHALMERS

What do you buy when you place a *Piping Contract?*





What you really buy is performance . . . and good value for your piping dollar. And how do you get these? By selecting a piping contractor who has a reputation for quality work . . . who is called upon to do job-after-job for the same customers. It's as simple as that.

Midwest is such a piping contractor. Midwest Piping is superior piping and good value for every piping dollar. We shall be happy to have you ask us to prove it.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • BOSTON 17—420 FIRST ST. LOS ANGELES 23—520 ANDERSON ST. • CHICAGO 3—70 WEST MONROE ST. TULSA 5—524 WRIGHT BLDG. • HOUSTON 2—1213 CAPITOL AVE. CLEVELAND 14—616 ST. CLAIR AVE. MIAMI 34—2103 LE JEUNE ROAD

PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN *50 Years*

6492

MIDWEST **PIPING FABRICATION and CONSTRUCTION**

OFFERS YOU MANY BENEFITS

A FEW MAJOR COCHRANE DEMINERALIZER INSTALLATIONS

- **Large Oil Company**
  Capacity 420,810 lbs. per hr.
  Automatic Control
- **Southern Paper Mill**
  Capacity 405,000 lbs. per hr.
  Automatic Control
- **Textile Manufacturer**
  Capacity 360,000 lbs. per hr.
  Automatic Control
- **Utility**
  Capacity 266,400 lbs. per hr.
  Automatic Control
- **Aluminum Producer**
  Capacity 387,000 lbs. per hr.
  Automatic Control
- **U.S. Government**
  Capacity 298,800 lbs. per hr.
  Automatic Control
- **Automobile Manufacturer**
  Capacity 182,268 lbs. per hr.
  Automatic Control
- **Pharmaceutical Company**
  Capacity 29,880 lbs. per hr.
  Automatic Control
- **Chemical Manufacturer**
  Capacity 15,000 lbs. per hr.
  Manual Control
- **Steamship Installation**
  Capacity 1,776 lbs. per hr.
  Manual Control

For your protection

buy **Cochrane's** *experience*

in demineralization

An impressive list of Cochrane 2-bed, 3-bed, 4-bed and mixed bed Demineralizer installations have been providing continuous protection for years in many outstanding high pressure power plants in public utility and industrial fields.

The illustration above is just one of many such installations. Designed for a large paper company, it produces an effluent with a silica content of as low as 0.02 ppm and total dissolved solids of as low as 0.4 ppm. Cation units are 6′ x 6′ and anion units 6′ x 8′ providing demineralized water supply of over 100,000 lbs. per hour for 1200 psi boilers.

Demineralized water quality is superlative. Cochrane's progress in solving the many problems associated with demineralization is the result of untiring research by their staff of chemists, engineers and research men. This background is your assurance of satisfactory operation. Why not take advantage of it? For the answer to your water conditioning problem . . . consult Cochrane first. Ask for Bulletin 5800-B.

COCHRANE CORPORATION WATER AND HEAT ENGINEERS SINCE 1863 PHILADELPHIA

Cochrane
CORPORATION

Representatives in 30 principal cities in U.S.; Toronto, Canada; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.
Pottstown Metal Products Division—Custom built carbon steel and alloy products

3106 N. 17TH STREET, PHILADELPHIA 32, PA.
NEW YORK • PHILADELPHIA • CHICAGO

Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Deaikalizers • Reactors • Deaerators • Continuous Blowoff Systems • Condensate Return Systems • Specialties

LOUIS N ROWLEY, EDITOR • AUGUST 1955 • ESTABLISHED 1882 **Power**

Atomic Nuts and Bolts

SINCE THE EALIEST DAYS of the Manhattan District project, the story of atomic development has been a struggle against technical difficulties of the toughest kind. Our stockpiles of atomic weapons and our prototype nuclear power plants stand as evidence of our ability to produce workable solutions.

Now, as we move into the development of large-scale nuclear plants for commercial service, these mechanical problems take on new importance. Designs suitable for small, experimental units won't always do for big ones intended for day-to-day operation. Answers that were economically feasible for military projects will be too costly for commercial application.

To get an idea of the nature of some of these "hardware" problems, look at just one aspect of the pressurized-water and boiling reactors in which there is so much current interest—the fuel system. The fuel elements must be fabricated from materials like uranium and plutonium, about which we still know little. They must be hermetically clad to prevent corrosion of the fuel metal and to safely contain the radioactive fission products generated when the fuel "burns." Last, but by no means least, these elements must be precisely spaced for uniform coolant flow, without local overheating—and this spacing must be maintained in operation.

In current reactor designs, fuel elements and other core parts, including control rods for setting power level, fit into a pressure-tight vessel. Then, to contain radioactive vapor that might be released by accidental rupture, the reactor vessel and the primary coolant system must be enclosed in another pressure-tight housing. With a boiling reactor, the entire plant needs to be so enclosed.

Sooner or later, the fuel elements must be replaced with new ones. Unsealing the reactor vessel, handling the radioactive fuel elements and resealing the vessel is neither easy nor quick. Yet for a truly commercial plant we need to make it so, to keep shutdown to a minimum.

These fuel-system problems are only part of the picture. We seek mechanical seals to meet new standards of tightness under conditions of extreme severity. We seek control-rod drives and control systems that achieve utmost reliability with greater simplicity. We seek long-lived water-lubricated bearings and a host of other "nut and bolt" items to meet the new demands of large-scale nuclear power.

Similar examples of needs for improved "hardware" can be cited for liquid-metal-cooled reactors and for new aqueous-homogeneous designs.

Long as a complete list of needed improvements would be, this situation cannot be anything but encouraging. The current drive to solve these problems is a clear sign that we're on the way to making nuclear power a truly commercial reality. Here is an enormous challenge to the ingenuity and skill of engineers—and a host of opportunities for manufacturers desiring a share in the nuclear future.

"WE CUT MOTOR REPAIRS FOR ONE OF OUR CUSTOMERS FROM 18 MOTORS PER YEAR TO 2 BY INSTALLING FUSETRON FUSES"

"The owner of a large poultry farm is one of our customers. In his operation a great number of motors are used in many different ways — pumps, feed grinders, heating systems, ventilators, etc.

"But these motors were giving him so much trouble that we were rewinding from 12 to 24 burned out motors a year for him.

"To correct the trouble, we suggested protecting the motors with Fusetron dual-element fuses. He told us to go ahead and try them. So, after checking the circuits and motors, Fusetron fuses were installed in proper sizes.

"Fusetron dual-element fuses proved themselves from the beginning. For the entire year following their application, only 2 motors were repaired and this trouble was caused by over lubrication.

"The motors we rewind are guaranteed for a year so we want to be sure they are properly protected. That's why we recommend to all our customers that they use Fusetron dual-element fuses."

Lawson E. Cobb
President
NEW ENGLAND ELECTRIC
MOTOR EXCHANGE INC.
GARDNER, MASS.

ROBERT E. HENRIKSON
Shop Foreman

FUSETRON is a trademark of Bussmann Mfg. Co.

Harlan F. Cobb
Vice President

FUSETRON dual-element FUSES do more than cut your motor repair costs

Fusetron fuses save you recalibration and maintenance costs

Fusetron fuses are *calibrated at the factory by engineers.* Once properly installed, they require no periodic inspection or down-time necessary on mechanically operated devices.

Fusetron fuses eliminate down-periods caused by needless blows

Fusetron fuses can increase production and reduce annoying interruptions of regular maintenance because — they wipe out needless blows caused by harmless overloads or excessive heating.

Fusetron fuses increase life of equipment

If there is an electrical fault, Fusetron fuses open and warn of danger and help hold fault to its source.

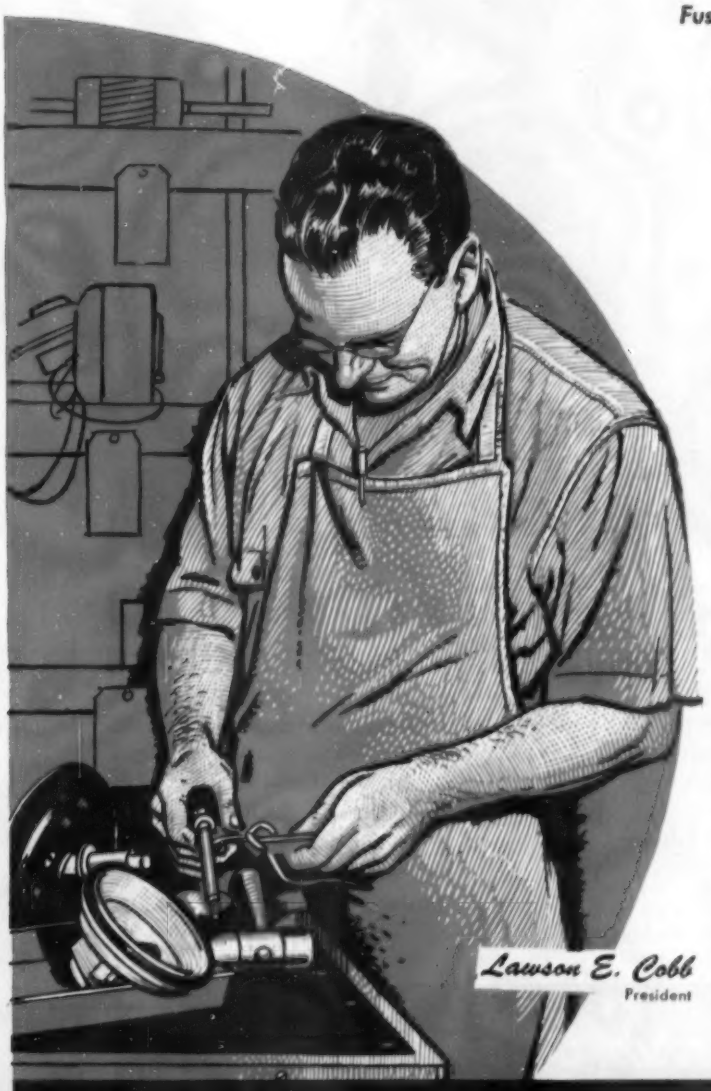
Panels and switches are protected against damage due to poor contact heating.

100,000 amp., interrupting rating gives you maximum safety

Fusetron fuses can safely interrupt the most severe available short circuit current — and are adequately safe to meet future circuit growth.

Fusetron fuses save on installation costs

They protect against waste of space and money by permitting use of proper size panels and switches, instead of oversize.



Lawson E. Cobb
President

Here's why Fusetron fuses give all-purpose protection

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance and an interrupting rating in excess of 100,000 amps.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses. FUSETRON Fuses fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Write for bulletin FIS.

For loads above 600 and up to 5,000 amps., Use BUSS Hi-Cap Fuses . . .

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

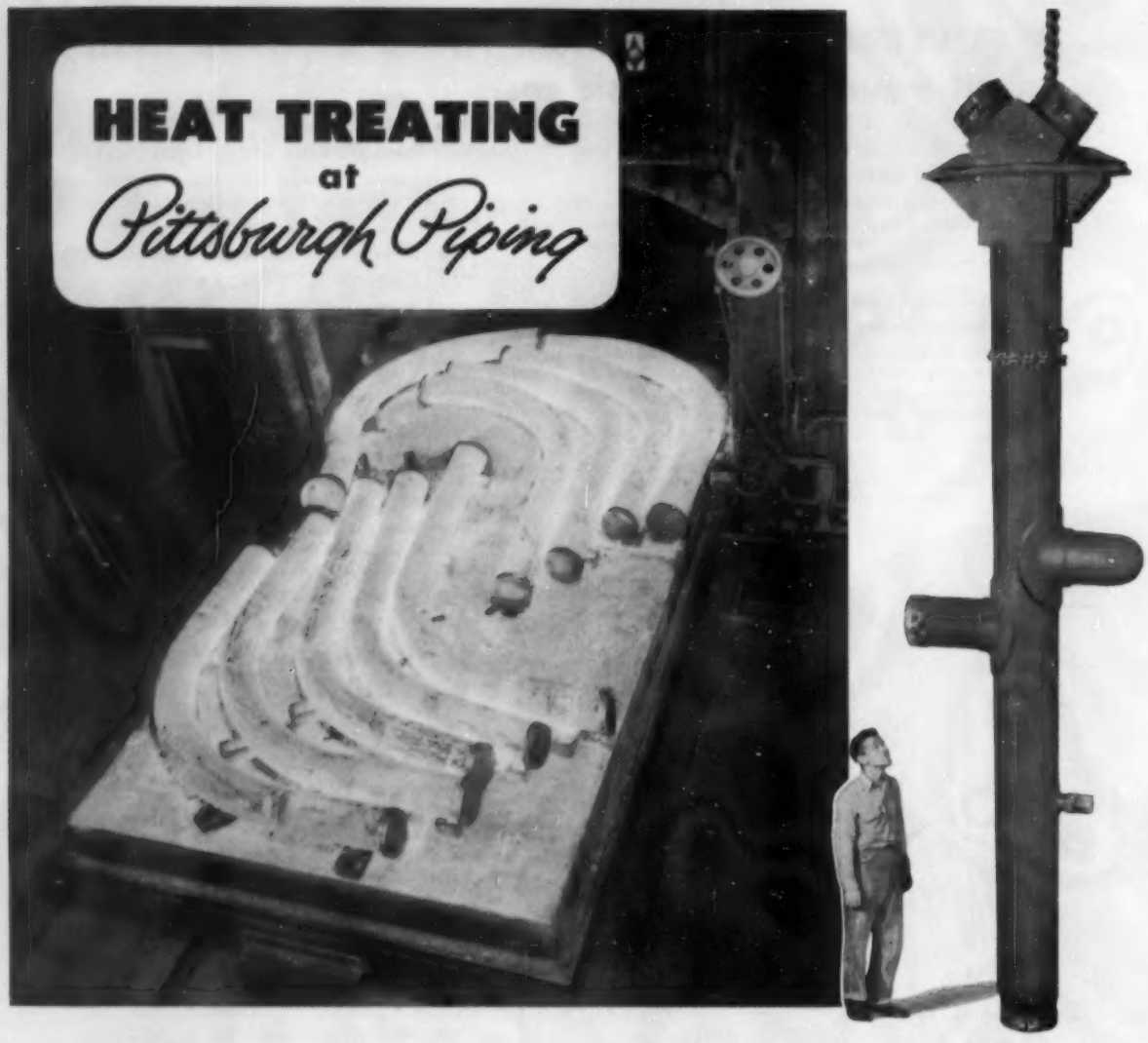
BUSSMANN MFG. CO. Div. of McGraw Electric Co.
University at Jefferson, St. Louis 7, Mo.

Play Safe! **install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!**

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

755

HEAT TREATING at Pittsburgh Piping



ASSURES PROPER TOUGHNESS, DUCTILITY, AND STRENGTH IN PIPING FOR HIGH TEMPERATURE, HIGH PRESSURE SERVICE

Heat treating and stress relieving at Pittsburgh Piping are operations which produce a uniform grain structure, assure consistent mechanical properties, and remove residual stresses throughout the length of each fabricated piping assembly.

P.P.&E.'s modern gas-fired furnace, illustrated above, is a specially-developed design. Time-temperature conditions can be electronically controlled in it for proper heat treatment of each type of metal.

This heat treating procedure is assurance that piping fabricated by P.P.&E. will have the most desirable combination of ductility, toughness, impact resistance, and strength.

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

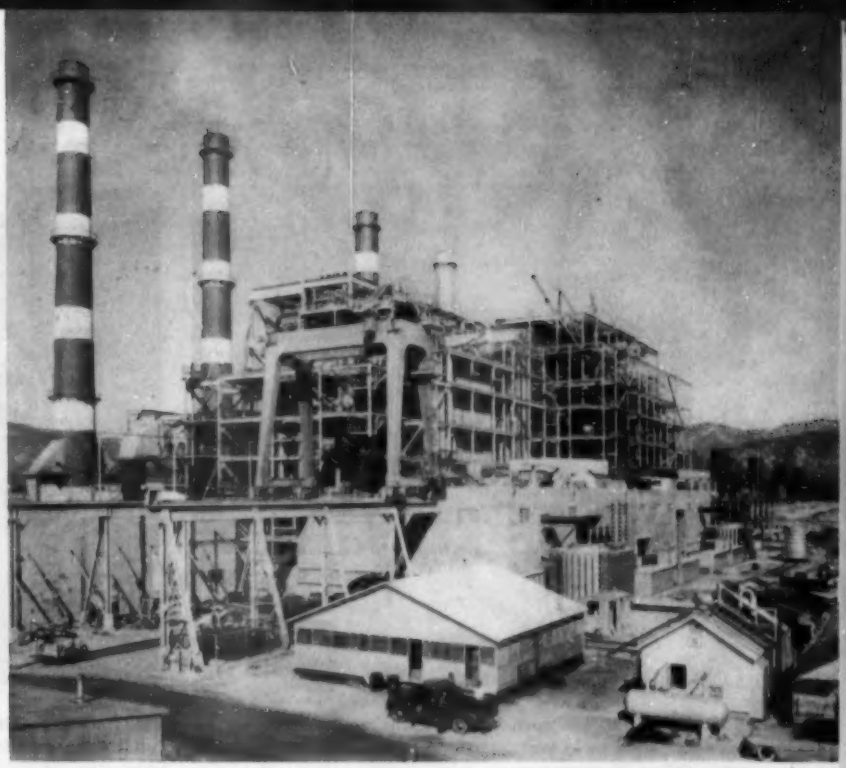
Pittsburgh Piping AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
825 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Houston	Heights State Bank Building
Los Angeles	1030 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street
Washington	Wire Building

PP-13

B G A SKROTZKI
Associate Editor in Charge



512,000-KW OUTDOOR STATION joins Los Angeles electric system in supplying electric energy to city. Valley Plant makes steam capacity dominant energy source

Today's design in VALLEY STEAM PLANT

- **Cooling towers supply the station circulating water**
- **Completely-outdoor boilers and turbine-generators**
- **Eliminating boiler steel casing speeds maintenance**
- **Centralized control rooms for pairs of main units**
- **Water makeup prepared by demineralization units**

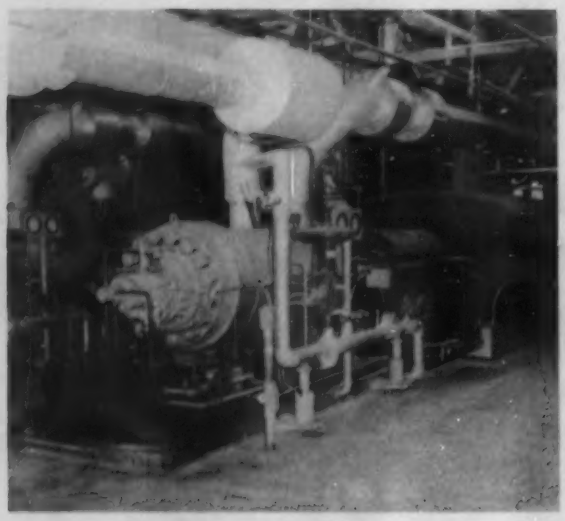
By B G HUME
Engineer of Steam Design
Department of Water and Power
The City of Los Angeles

► THE VALLEY STEAM PLANT of the Los Angeles Department of Water and Power stands in the San Fernando Valley in the northern part of the city. The plant feeds power into the northern and western parts of the electrical system. The ultimate plant capacity of 512,000 kw will be in four units. First two units are now running and the second two are under construction.

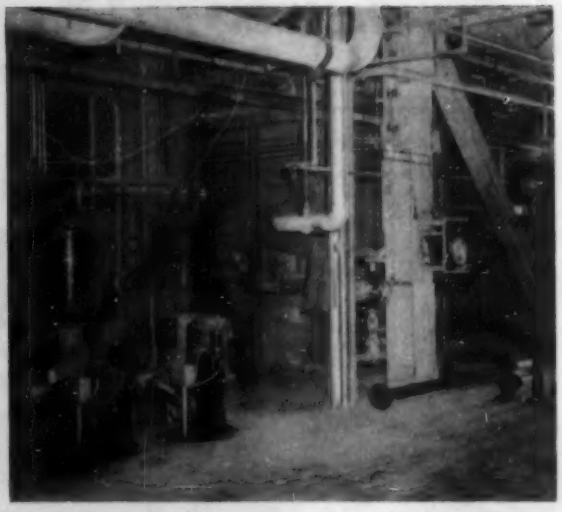
We had made economic studies of plant location: on the seashore versus its present site, 20 miles from the shore. Sea water would be used for cooling at the shore and cooling towers at the inland site. Taking into account costs of electrical transmission, fuel transportation, condenser vacuum and other factors, there was little difference in generating a kwhr at either site.

Ample area at the inland site permits placing the cooling towers some distance from the plant, see photo above. Wide space between towers minimizes recirculation of moist air discharged from the fans. Orientation on the site minimizes down drafts that might draw the discharged vapors down to ground level.

The plant is one of the largest steam-



BOILER FEED PUMPS each have 60% of maximum boiler-flow capacity. Each main unit has three motor-driven feed pumps



VERTICAL CONDENSATE PUMPS serve the 55,000-sq-ft main condensers of Units 1 and 2; have 10-ft water submergence

electric stations to use cooling towers. Thirty-foot stacks on top of the induced-draft towers discharge the warm, moist air about 60 feet above the cold-air intakes.

To eliminate costly manifolding, separate small towers serve the needs of bearing cooling, hydrogen cooling, oil cooling and other demands. This permits treating cooling water for main condensers and the smaller auxiliaries separately should it be necessary.

The plant site can accommodate a one-million-barrel oil-storage tank farm and coal storage for up to three months' operation if needed in the future.

Plant layout. Each turbine receives steam from its one boiler. Units 1 and 2 run on the straight regenerative cycle at 1450 psig and 1000 F to develop capabilities of 100 mw each. Because of the high percentage of hydroelectric power on the system, these steam units have a 40:1 load range, but not quick pickup.

Units 3 and 4 with capabilities of 156.25 mw each run on the reheat cycle at 1800 psig and 1000/1000 F. These two units can carry minimum loads of about 20% of full load.

The units are arranged in pairs with operating centers housing chemical feed equipment, locker rooms, instrument shops, control rooms and terminal rooms. The operating centers stand between the pairs of boilers. Main plant equipment is outdoors, except the two central enclosures and space below the turbine operating deck.

Water-treatment equipment and service pumps stand between the stacks of Units 2 and 3. With the exception of the control room and the dry chemical storage, all this equipment is outdoors.

Administration and service building, at one end of the crane runway, houses offices, laboratory, shops and warehouse. A spur track and the main gantry crane serve shops and warehouse. The crane runway extends beyond the turbine deck to help load and unload rail cars and trucks.

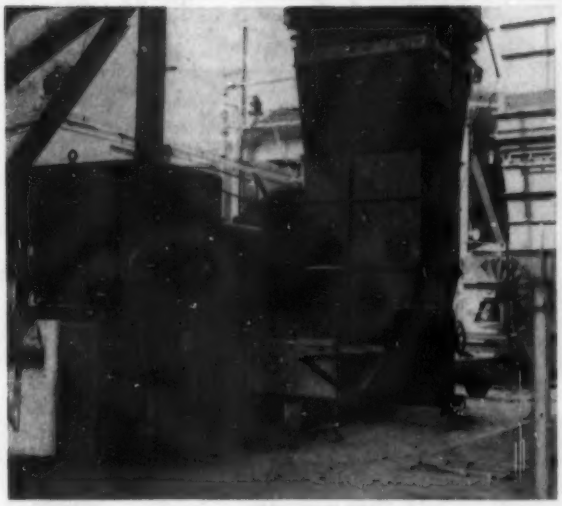
Turbine - generators, fitted with weather-tight casings and walk-in exciter housings, are outdoors on the turbine deck. All starting and stopping (excepting emergency shutdown) must be done from the turbine deck. Loading is regulated from the enclosed control room. Complication and cost of remote starting and stopping from the control room were unjustifiable. We consider close personal supervision of these machines during starting and stopping highly desirable.

Feedwater heaters raise feed temperature in five stages on Units 1 and 2. The two low-pressure heaters are contained in a single shell, in the connecting piece between turbine exhaust and condenser. A vertical baffle through the shell and channels make each half available for a separate heating stage. The deaerator does the third-stage heating followed by two high-pressure vertical heaters on the turbine deck.

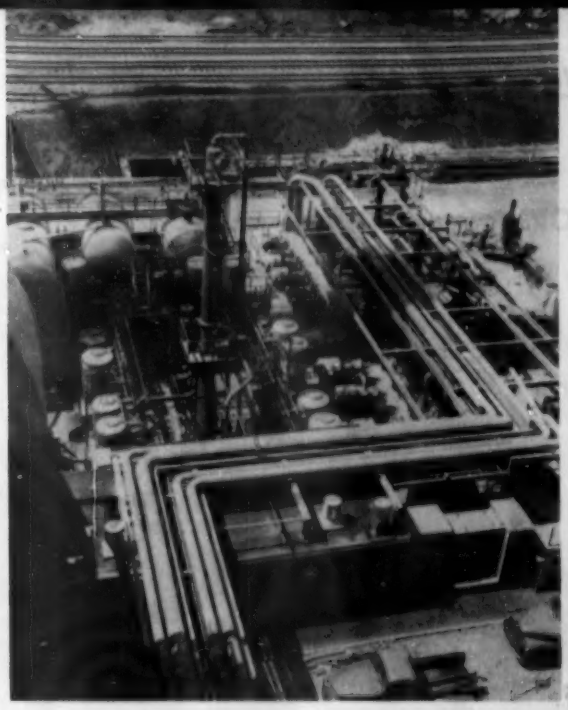
Units 3 and 4 each have six stages of feed heating. The l-p heaters and the deaerator are similar to Units 1 and 2. The three h-p stages of heating use two parallel circuits with three heaters in each. To isolate any h-p heater on the feedwater side, the bank of three must be taken out of service. These heaters are horizontal because of the greater simplicity and more satisfactory arrangement for built-in drain coolers and desuperheating zones. The shells can be withdrawn on these heaters to avoid breaking h-p joints. Piping is welded to the channel nozzles.

Boilers were designed with outdoor weather-tight settings having furnace walls of tube-supported unit-suspended tile with mineral-wool block, insulated plastic covering. We preferred this to outside steel casing—it lets operators keep a continuous check on incipient cracks that might cause gas leakage. Furnace can be easily maintained without removing steel casings.

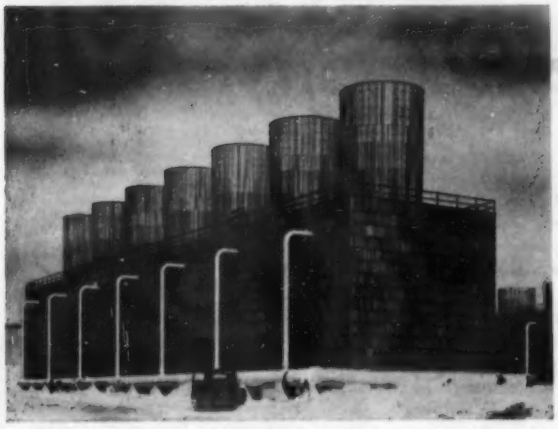
These boilers are designed for burning powdered coal if it ever should become necessary. There is space for future pulverizers and coal-handling



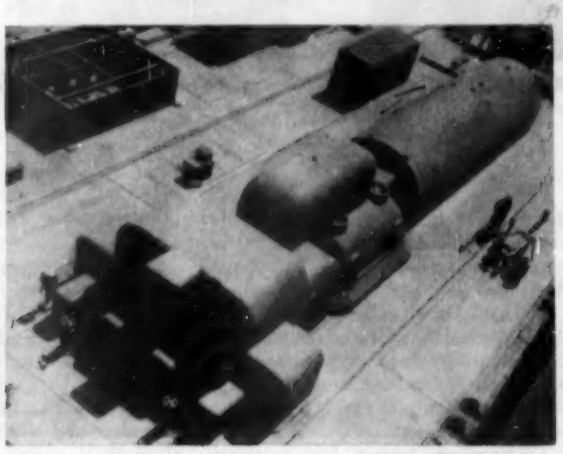
FORCED-DRAFT FAN for Unit 1 handles 142,000 cfm of air; the hydraulic coupling allows operation at variable speed



DEMINERALIZING PLANT and service pumps stand between the stacks of Units 2 and 3, serve all four units of Valley Plant



INDUCED-DRAFT COOLING TOWER with seven cells supplies half of the circulating-water needs for one 100-mw turbine



TURBINE-GENERATOR UNIT 1 has a maximum capability of 100,000 kw; walk-in enclosure over direct-connected exciter

apparatus when needed. Oil and gas burners can be readily converted to coal by installing the pulverized-coal sleeves.

Experience with other units on our system burning the present fuel oils indicates considerable advantage in large furnaces. We decided that a furnace suitable for coal would burn fuel oil and gas satisfactorily—no modification will be needed to convert to coal.

Steam temperature must be kept up to rating over as much of the load range as possible on the wide-range units. A combination of gas recirculation and burner control does this on Units 1 and 2. At low loads the lower burners are shut down and the upper ones fired at higher burning rates. Two steam-atomizing burners fire the boiler at very low loads and during starting.

Spray attemperation at high loads prevents excessive steam temperature.

Steam heating coils in the f-d fan discharge ducts protect the air preheater from excessive corrosion during low loads. These steam heaters have enough capacity to serve loads up to 100% rating should it become necessary to burn high-sulfur fuels. They prevent condensation and corrosion in the air heaters due to a high dewpoint and fuel oil with 5% sulfur. Our present oil has less than 2% sulfur.

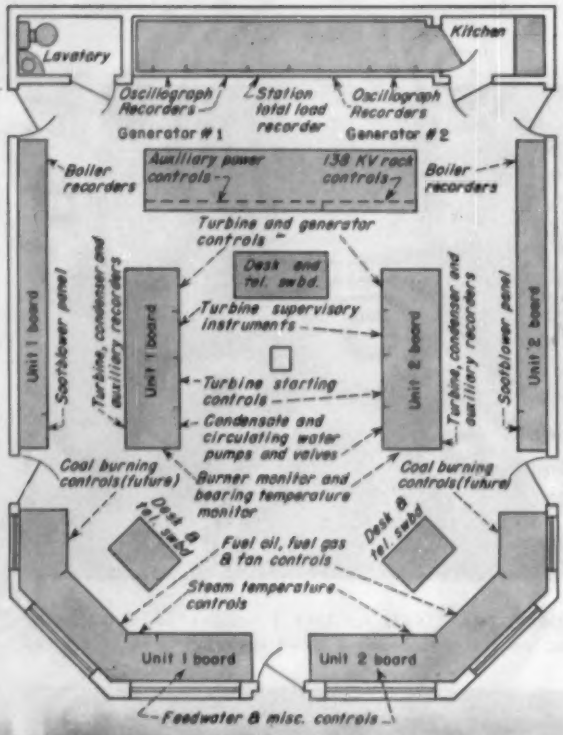
The tubular air heaters have two passes with cold ends in the last pass in downward position. Corroded tubes in the last pass can be removed without replacing tubing for the entire length of the heater.

Reheat boilers for Units 3 and 4 use a combination of burner, damper, and spray control on steam temperature. The burners, arranged in four vertical rows of five each, fire the furnace compartments at different rates. The operator can control reheat with relation to main temperature or maintain high steam temperature over a wide load range.

The vertical regenerative heaters have the cold end of the heating elements

Outdoor plant uses centralized controls for operation method

BOILER-CONTROL OPERATOR oversees the benchboard for one unit from his desk, which carries a telephone switchboard



CENTRALIZED CONTROL ROOM has three operators to run two units: two men for boilers, one for turbine, electrical

down so surface can be removed to raise cold-end temperature if excessive corrosion occurs. The f-d fan discharge ducts also have steam heaters installed.

Mechanical dust collectors reduce ash discharge from stacks when burning oil and operating soot blowers. Space back of the boilers can accommodate electrostatic precipitators if coal is fired in the future.

Oil-handling system has a steam heater in each storage tank. All lines between storage and service tanks are steam traced. We presently burn oil with 300 ssf viscosity at 122 F. We hope we can burn oil with viscosities up to 600 ssf, because of the fuel-cost saving.

Gas will be bought on a dump basis. This means that oil in the handling system must be kept circulating and hot at all times.

Water treatment uses the demineralization process with second-stage cation and silica absorbers. The automatically controlled system uses a vacuum deaerator to reduce CO_2 and chemical costs. This system will produce water with a dissolved solid content not over 1 ppm, including 0.2-ppm silica and zero CO_2.

Sulfuric-acid treatment of the makeup maintains a pH between 7.0 and 8.0 in the main-cooling-tower water. Return water from the condensers is treated with sodium polyphosphate; bromine will control slime.

Auxiliaries are all motor driven and located above grade to minimize outages caused by flooding. No emergency turbine-driven boiler feed pump has been provided. There are two sources of auxiliary power supply and an outside source for making cold starts if necessary. Three boiler-feed pumps serve each boiler. Each pump has a maximum capacity of 60% of maximum flow to the boiler. All pumps can start automatically according to load.

Condensate pumps, three for each unit, are of the vertical, turbine, can type with over 10 ft of submergence.

Control rooms are laid out so operators at the boiler benchboards see the main operating floor through glass windows above the boards. One operator at each boiler board supervises combustion, feedwater and steam-temperature controls. The turbine operator is stationed in the center of the room with a turbine board on each side as he faces the electrical board at the rear of the room.

The control rooms contain all electrical controls for the switchboard. All turbine supervisory instruments are on the turbine boards as well as the usual oil, steam and bleed-point pressure gages. Turbine recorders mount on back of the turbine board, while boiler recorders are on a board back of the turbine board. This arrangement contributed to compactness of the control rooms. Other helpful factors are small-size instruments and control selectors, and elimination of back-of-board piping. All control impulses and indications are brought into the control room from remote transmitters, near the measuring points, either pneumatically or electrically.

This eliminates all h-p piping from the control rooms, shortens piping runs and enables placing transmitters for easy maintenance. All control air in the room is at less than 30 psig. All tubing between transmitters and terminal room is in prefabricated metallic semi-flexible cables containing up to 12 tubes.

Control-air tubing for the cooling towers is buried in the ground. It is made of plastic tubing encased in a plastic cover and pulled into Transite or fiber ducts. This arrangement reduces costs and prevents corrosion.

PRINCIPAL POWER-PLANT EQUIPMENT

Valley Steam Plant, Los Angeles Department of Water and Power, Calif.

UNITS 1 AND 2

STEAM-GENERATING EQUIPMENT:

Boilers, 2 ..... Babcock & Wilcox Co
850,000 lb per hr, 1500 psig, 1000 F, radiant type, gas and oil fired, 12,362-sq-ft waterwalls, 4243-sq-ft boiler, 2623-sq-ft saturated steam connections, 18,275-sq-ft primary superheater, 11,070-sq-ft secondary superheater, 16,208-sq-ft economiser surfaces

Air heaters, 2 ..... Babcock & Wilcox Co
Vertical, tubular, 2 sections, 160,208-sq-ft surface

Forced-draft fans, 4 ..... Buffalo Forge Co
142,000 cfm, 105 F, 21.5 in. water, 1200 rpm

Induced-draft fans, 4 ..... Buffalo Forge Co
235,000 cfm; 365 F, 16.6 in. water, 900 rpm

Hydraulic fan couplings, 8 ..... American Blower Corp

Forced-draft-fan motors, 4 ..... Elliott Co
700-hp, 1200 rpm, 4000-v induction motors

Induced-draft-fan motors, 4 ..... Elliott Co
900-hp 900-rpm 4000-v induction motors

Burners, 24 ..... Peabody Engineering Corp
Wide-range mechanical atomizing guns, alloy-steel tips and plugs; steel-tip caps, ring-type gas burners—18-8 stainless steel

Soot blowers, automatic sequential..... Diamond Power Specialty Corp

POWER-GENERATING EQUIPMENT:

Turbine-generators, 2 ..... Westinghouse Electric Corp
100,000-kw capability, 1450 psig, 1000 F, 2.5 in. Hg, double-flow tandem compound, 3600 rpm, 37 stages, 5 bleed points, 115,000 kva, 0.87 pf, 15-psi hydrogen, 13,800-v generator, geared exciter

Surface condensers, 2 ..... The Lummus Co
55,000 sq ft, single pass, divided water box, ¾-in. OD, 18 gage, 30-ft long Admiralty metal tubes, Naval rolled brass tube sheets, CI water boxes

Circulating water pumps, 2 ..... Worthington Corp
Horizontal, centrifugal, 36,000 gpm, 54-ft total head, 700-hp motors, 440 rpm pump

Cooling towers, 4 ..... The Fluor Corp, Ltd
7 cells, 252 ft x 42 ft, 336,000-sq-ft evaporating surface, 70-F wet bulb, 11-F approach

FEEDWATER SYSTEM:

Boiler feed pumps, 6 ..... Byron Jackson Co
500,000 lb per hr, 11 stages, horizontally split inner case, 1634 psig discharge pressure, 3470 rpm

Boiler-feed-pump drives, 6 ..... Electric Machinery Mfg Co
1500-hp 4000-v outdoor splashproof motors

Boiler-feed-pump hydraulic couplings, 6 ..... American Blower Corp

Drain coolers, 2 ..... The Lummus Co
Horizontal, single pass, 555 sq ft, ¾-in. OD Admiralty tubes

Combined low-pressure heaters, 2 ..... The Lummus Co
Two heaters in single shell, 2-pass, horizontal, 3660 sq ft combined surface, ¾-in. OD Admiralty tubes

High-pressure heaters, 4 ..... The Lummus Co
Vertical, 2 pass, 2900 sq ft, ⅝-in.-OD 80-20 cupro-nickel tubes

Deaerating heaters, 2 ..... The Permutit Co
800,000 lb per hr, spray type, 0.005 cc O_2 per liter, external tubular vent condenser, 20,000 gal storage tank

FUEL-OIL SYSTEM:

Fuel-oil heaters ..... Southwestern Engineering Co
1835 sq ft, 6 pass, vertical, ¾-in.-OD 14-BWG 16-ft carbon steel tubes, steel tube sheets, oil in tubes

Drain coolers, 4 ..... Southwestern Engineering Co
780 sq ft, single pass, vertical, ¾-in.-OD 14-BWG 16-ft carbon steel tubes, steel tube sheets, oil in tubes

Fuel-oil storage tanks, 3 ..... Chicago Bridge & Iron Co
171,900 bbl, pan-type floating roof, manhole-type steam heaters

Fuel-oil service pumps, 2 ..... Sier Bath Gear & Pump Co, Inc
Horizontal, screw, 150 gpm, 650 psi total head; 150/75 hp motor

Fuel-oil booster pumps, 2 ..... United Centrifugal Pumps
Vertical, centrifugal, 150 gpm, 30-ft total head, 7.5 hp motor

Fuel-oil handling pumps, vertical ..... United Centrifugal Pumps

MISCELLANEOUS EQUIPMENT:

Transformers, 2 ..... Allis-Chalmers Mfg Co
110,000 kva, 3 phase, 13.8/138 kv self cooled, forced-air cooled

Service air compressors, 2 ..... Worthington Corp
Single stage, double acting, horizontal, reciprocating, 300 cfm free air at 125 psig, 75-hp motor

Instrument air compressors, 2 ..... Worthington Corp
Single stage, double acting, horizontal, reciprocating, carbon ring, 300 cfm free air, 100-psig, 75-hp motor

Chemical feed systems ..... Milton Roy Co

Controls ..... Bailey Meter Co
Combustion, feedwater, steam temperature

UNITS 3 AND 4

STEAM-GENERATING EQUIPMENT:

Boilers, 2 ..... Riley Stoker Corp
1,200,000 lb per hr, 1850 psig, 1000/1000 F, reheat, gas and oil fired, 4100-sq-ft boiler, 18,400-sq-ft waterwalls, 95,000-sq-ft superheater, 22,500-sq-ft resuperheater, 23,000-sq-ft economizer

Air heaters, 2 ..... Air Preheater Corp
Ljungstrom regenerative type, 137,100 sq ft surface

Forced-draft fans, 4..... Westinghouse Electric Corp, Sturtevant Div
207,000 cfm, 80-F air, 19-in. water, 1200 rpm

Induced draft fans, 4 ..... Buffalo Forge Co
365,000 cfm, 300-F gas, 17 in. water, 900 rpm

Fan hydraulic couplings, 8 ..... American Blower Corp

Forced-draft fan motors, 4 ..... Westinghouse Electric Corp
800 hp, 1200 rpm, 4000 v induction motors

Induced-draft fan motors, 4 ..... General Electric Co
1250-hp, 900 rpm, 4000-v induction motors

Burners, 40 ..... Peabody Engineering Corp
Wide range mechanical atomizing oil guns; alloy-steel tips and plugs, steel tip caps, ring type gas burners, 18-8 stainless steel

Soot blowers....Copes-Vulcan Div, Continental Foundry & Machine Co
Automatic sequential

TURBINE-GENERATOR EQUIPMENT:

Turbine-generators, 2 ..... General Electric Co
156,250-kw capability, 1800 psig 1000/1000 F, reheat, 2.5-in. Hg, triple-flow tandem compound, 3600 rpm, 31 stages, 6 bleed points, 183,823 kva, 0.85 pf, 30-psi hydrogen, 18,000-v generator, geared exciter

Surface condensers, 2 ..... The Lummus Co
90,000 sq ft, 2 pass, divided waterbox, ¾-in. OD, 18 gage, 30-ft Admiralty metal tubes, Naval rolled brass tube sheets, fabricated steel waterboxes

Circulating water pumps, 2 ..... Peerless Pump Div, Food Machinery & Chemical Corp
Horizontal, centrifugal, 35,000 gpm, 74-ft total head, 800-hp motors, 438 rpm

Cooling towers, 4 ..... The Fluor Corp, Ltd
5 double cells, 180x66 ft, 475,820-sq-ft evaporating surface, 70-F wet bulb, 10-F approach

FEEDWATER SYSTEM:

Boiler feed pumps, 6 ..... United Centrifugal Pumps
13 stages, horizontally split inner case, 600,000 lb per hr, 2674-psig discharge, 3470 rpm

Boiler-feed-pump motor drives, 6 ..... Elliott Co

Boiler feed-pump hydraulic couplings ..... American Blower Corp

Drain coolers, 2 ..... The Lummus Co
Horizontal, single pass, 740 sq ft, ¾-in. Admiralty tubes

Combined low-pressure heaters, 2 ..... The Lummus Co
Two heaters in single shell, 2 pass, horizontal, 3650-sq-ft combined surface, ¾-in. Admiralty tubes

High-pressure heaters, 12 ..... The Lummus Co
Horizontal, 4 passes, ⅝-in.-OD 70-30 cupro-nickel tubes
4 heaters—2660 sq ft each (No. 4 pairs)
4 heaters—2500 sq ft each (No. 5 pairs)
4 heaters—3075 sq ft each (No. 6 pairs)

Deaerating heaters, 2 ..... The Permutit Co
1,025,000 lb per hr, spray type, 0.005 cc O_2 per liter, external tubular vent condenser, 20,000-gal storage tank

FUEL-OIL SYSTEM:

Fuel oil heaters, 4 ..... Southwestern Engineering Co
1800 sq ft, 4 passes, vertical, 1-in. OD, 12 BWG, 16-ft carbon steel tubes and tube sheets, oil in tubes

Drain coolers, 4 ..... Southwestern Engineering Co
660 sq ft, 1 pass, vertical, 1-in. OD, 12 BWG, 16-ft carbon steel tubes and tube sheets, oil in tubes

Fuel-oil service pumps, 2 ..... United Centrifugal Pumps
Vertical, centrifugal, 200 gpm, 658 psi total head, 250 hp motor

Fuel-oil handling pumps ..... United Centrifugal Pumps

Fuel-oil storage tanks, 3 ..... Consolidated Western Div, United States Steel Corp
171,900 bbl, pan type floating roof tanks, manhole type steam heaters

MISCELLANEOUS EQUIPMENT:

Transformer, 1 (Unit 3) ..... Allis-Chalmers Mfg Co
186,667 kva, 3 phase, 16/138 kv, self-cooled forced air cooled

Transformer, 1 (Unit 4) ..... Westinghouse Electric Corp
186,667 kva, 3 phase, 18/138 kv, forced oil cooled with forced-air coolers

Air service compressors, 2 ..... Worthington Corp
Single stage, double acting, horizontal, reciprocating, 300 cfm free air, 125 psig, 75-hp motor drive

Instrument air compressors, 2 ..... Worthington Corp
Single stage, double acting, horizontal, reciprocating, carbon ring, 400 cfm free air, 100 psig, 100-hp motor

Chemical feed systems ..... Milton Roy Co

Control systems ..... Bailey Meter Co
Combustion, feedwater, steam temperature

STATION EQUIPMENT:

Fuel-oil gaging tanks, 2 (12,500 bbl)..... Chicago Bridge & Iron Co

Raw-water storage tank 1 ..... Consolidated Western Steel Div, U.S. Steel Corp

Demineralizer ..... The Permutit Co
100 gpm, 2 stage with vacuum deaerator between stages, 1 ppm total solids, 0.2 ppm silica, zero CO_2

Turbine crane ..... Moffett Engineering Co

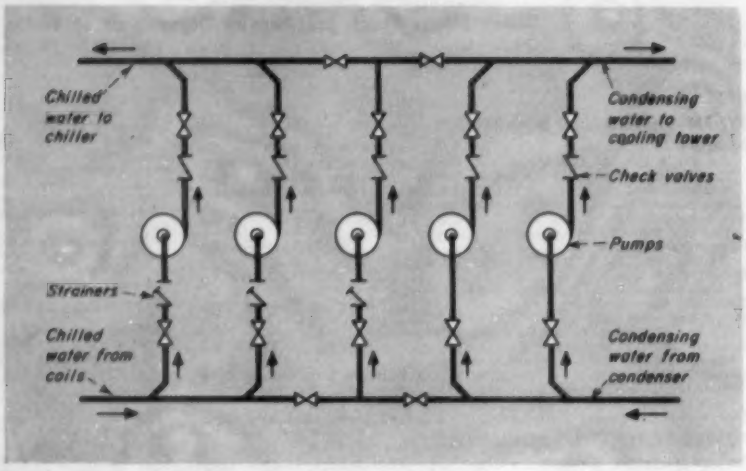
Circuit breakers, 138 kv ..... Westinghouse Electric Corp

Auxiliary power centers, 4160 v..... Westinghouse Electric Corp / General Electric Co

Temperature and load recorders ..... Leeds & Northrup Co

FIRST OF TWO ARTICLES

By R A ROSTON,
Air-Conditioning Engr
Kerby Saunders, Inc



COMMON HEADERS tie chilled water and condensing water systems together. Two pumps per system handle normal load. Spare pump, center, acts as common standby

Air conditioning for multi-story

Nailing down design and selection of air conditioning for an existing multi-story building calls for careful figuring plus sound judgment. Here's your step-by-step guide

► IN MANY AREAS of the U.S. a new institutional building without air conditioning would be as obsolete as a *Model T* Ford. Even existing buildings are going in for air-conditioning plants in a big way. And the power-services engineer works hand-in-hand with air-conditioning specialists in formulating a system design.

When this assignment falls to you, you'll need a basic understanding of initial surveys, cooling-load figuring and equipment selection. So we're going to put this know-how at your fingertips. We'll work out a step-by-step solution that you can use as a guide in designing and choosing an air-conditioning system for a multi-story building.

Initial survey. In defining the problem, let's assume your building is in Minneapolis, Minnesota. For this area the "1955 Guide," *table 2, p 274*, published by the *American Society of Heating and Air-Conditioning Engineers*, recommends 95-F dry-bulb temperature and 75-F wet-bulb temperature for outdoor design conditions. We've plotted this figure on a skeleton ASHAE psychrometric chart, *page 80*.

The building is exposed on three sides, with one wall adjacent to another building. Long-side of the structure has a northern exposure. One of the short sides, facing east, gets shade from the adjacent building. So this side gets no heat gain from morning sun. Western side is completely exposed and we'll have to consider the afternoon sun load here. Thus, cooling load must account for the heat gain, due to heat transmission, through north and south walls, and afternoon sun load on the western exposure. Since the adjoining building, east, is completely air conditioned, it's safe to assume that we'll get no heat transfer through the east wall.

We needn't worry about sun load on the top occupied floor, since there's a service floor above it that houses elevator machinery, house tanks and storage. But we'll have to account for heat transmission due to temperature difference between the top occupied floor and the service floor.

Building materials play a big part in cooling-load figuring. So be sure to examine construction and building materials in the initial survey. On this job we find that the building walls are four-inch brick veneer backed up with eight-inch hollow tile. Inside walls are finished with half-inch plaster. Win-

Summary of heat gained through outside walls

Exposure	*Net area, sq ft	Equiv temp diff, F	Heat transmission coeff, Btu/hr/sq ft	Heat gained, Btu/hr
North	1800	2	0.32	1150
East	624	8	0.32	1600
West	383	6	0.32	735
Total				3485

*Net area is gross area less window area

Summary of heat gained through glass area

Window exposure	Area, sq ft	Shade factor	Btu/hr/sq ft: Solar radiation	Convection radiation	Heat gain rate	Total gain, Btu/hr
North	615	—	14	16	30	18,450
East	168	—	12	16	28	4,700
West	112	0.56	205	20	225	14,120
Total						37,270

Summary of total heat gain

	Btu/hr	Btu/hr
Room load		
Sensible		
Walls	3,485	
Glass	37,270	
Ventilation air	2,755	
People	20,000	
Lights	123,000	
Fan motors	30,000	
Sub-total		216,510
Latent		
Ventilation air	2,760	
People	25,000	
Sub-total		27,760
Outside air load		
Sensible	24,800	
Latent	24,850	
Sub-total		49,650
Grand total		293,920

buildings: Designing the system

dows are single-pane glass. Occupants use venetian blinds throughout.

Heat gained from lights and people make a substantial contribution to the cooling load. And in an existing building it's easy to get an accurate figure for this part of the load. Each floor, equipped with fluorescent lighting, carries a 30,000-watt load. The survey also shows that there are about 100 people per floor.

Temperature and humidity of conditioned air depends on $$ available for equipment and desired comfort level. *ASHAE Guide, table 1, p 270,* lists typical conditions. We'll use 78-F dry-bulb temperature and 50% relative humidity for peak-load figuring. During normal load periods the system produces 75-F or 76-F inside temperatures.

Ventilation requirement for general offices is 15 cfm per person, *ASHAE Guide, table 3, p 277.*

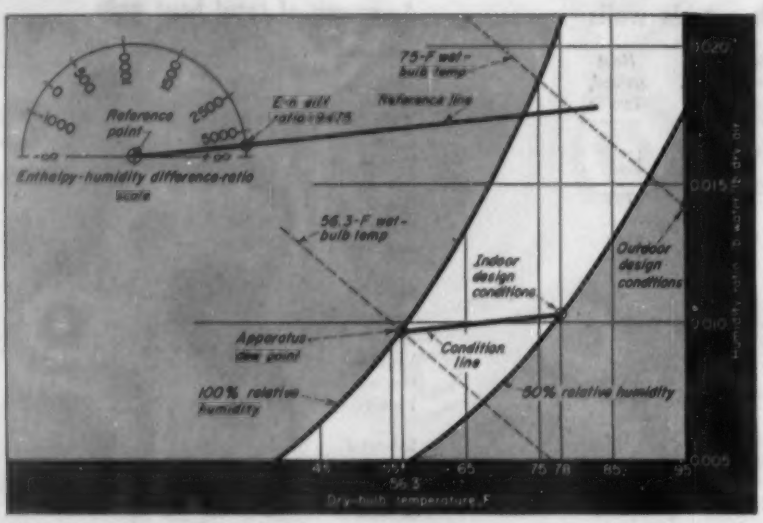
Cooling load. We've now completed the initial survey and picked design conditions. Next comes actual cooling-load figuring. Cooling load divides into: (1) sensible heat gain—direct heat addition resulting in dry-bulb temperature boost and (2) latent heat gain—addition of moisture to the air from people or processes. Although dry-bulb temperature isn't affected by latent heat gain, relative humidity is. Cooling equipment must have the added capacity needed to condense water vapor and maintain a constant relative humidity.

Total sensible heat gain includes direct solar radiation, heat transmission resulting from inside-outside temperature difference, lighting load, people and ventilating air.

ASHAE Guide, table 13, p 295, shows that biggest solar heat gain, at 40-degrees north latitude, takes place at 4 pm from west exposure. This 205-Btu-

SYMBOLS

q_{sz} = sensible ventilation load contacting conditioner coils, Btu/hr
q_{sz} = latent ventilation load contacting conditioner coils, Btu/hr
q_{s1} = sensible ventilation load becoming part of room load, Btu/hr
q_{s1} = latent ventilation load becoming part of room load, Btu/hr
Q = entry rate of outside air, cfm
t_o = outdoor dry-bulb temp, F
t_i = indoor dry-bulb temp, F
W_o = outdoor humidity ratio, lb moisture/lb dry air
W_i = indoor humidity ratio, lb moisture/lb dry air
b = coil bypass factor = 0.1



ASHAE PSYCHROMETRIC CHART, in skeleton form, shows how to find apparatus dew point. Draw reference line through reference point and e-h difference ratio, 9475. Draw condition line parallel to reference line, through indoor design conditions

For an effective system, get right balance between outside air and return air

per-hr-per-sq-ft heat gain pins down time of peak load. So we'll figure peak load at 4 pm.

Outside-wall heat gain depends on the equivalent temperature difference for the wall and its heat-transmission coefficient. Equivalent temperature differences for a 12-inch light-colored brick wall (about equal to 4-inch brick veneer and 8-inch hollow tile) at 4 pm, are: 2 F for north exposure, 8 F for east exposure and 6 F for west exposure, *ASHAE Guide, table 10, p 286.* Heat transmission coefficient for the wall we're considering is 0.32 Btu per-hr-per-sq-ft *ASHAE Guide, table 9, p 187.* Summary of heat gained through outside walls, *top of page 79,* tabulates results.

Glass-area heat gain includes: (1) solar radiation and (2) convection, radiation.

We've already noted the max solar-radiation heat gain—205 Btu per-hr-per-sq-ft—for west exposure. Shade factor, taking account of venetian blinds, trims down this gain. *ASHAE Guide, table 24, p 303,* lists 0.56 shade factor for white venetian blinds set at 45 degrees. Solar heat gain through north windows is 14 Btu per-hr-per-sq-ft. Through east windows, 12 Btu per-hr-per-sq-ft, *ASHAE Guide, table 13, p 295.*

Convection and radiation heat gain, *ASHAE Guide, table 14, p 295,* is: north 16, east 16, west 20. Summary of heat gained through glass area, *top of page 79,* shows how to figure total Btu's.

Ventilation air. During initial survey we specified ventilation needs at 15-cfm per person. So total ventilation air per floor is, in cfm:

100 people × 15 cfm/person = 1500

Since ventilation air comes from outside, it's part of the cooling load. By far the largest part of this outside air contacts cooling-coil surfaces. For equipment we're using, about 10% passes through cooling coils without contacting them. So we base heat gained from outside air on a 0.1 bypass factor. Also, heat-gain figuring is divided into two parts: (1) air-flow contacting coil and cooled almost to the cooling-unit dew point and (2) air-flow bypassing the coil and becoming part of the room load.

Sensible load from ventilation air contacting coil is:

$q_{sx} = Q \times 1.08\ (t_o - t_i)\ (1 - b)$
$= 1500 \times 1.08\ (95 - 78)\ (0.9)$
$= 24{,}800$ Btu/hr

Latent load from ventilation air contacting coil is:

$q_{sx} = Q \times 4840\ (W_o - W_i)\ (1 - b)$
$= 1500 \times 4840\ (0.0141 - 0.0103)\ (0.9)$
$= 24{,}850$ Btu/hr

Sensible load becoming part of room load is:

$q_{si} = Q \times 1.08\ (t_o - t_i)\ (b)$
$= 1500 \times 1.08\ (95 - 78)\ (0.1)$
$= 2755$ Btu/hr

Latent load becoming part of room load is:

$q_{si} = Q \times 4840\ (W_o - W_i)\ (b)$
$= 1500 \times 4840\ (0.0141 - 0.0103)\ (0.1)$
$= 2760$ Btu/hr

People and lights. It's easy to figure heat gained from these sources since, from initial survey, we know the number of people per floor and the lighting load. *ASHAE Guide, table 25, p 308,* lists 200-Btu-per-person-per-hr sensible heat gain, and 250-Btu-per-person-per-hr latent heat gain. Based on 100-people per floor sensible heat gain is:

100 × 200 Btu/hr
= 20,000 Btu/hr

Latent heat gain is:

100 × 250 Btu/person/hr
= 25,000 Btu/hr

Lighting heat gain includes a 1.2 allowance factor for ballast power load:

30,000 watts × 1.2 × 3.413 Btu/watt-hr
= 123,000 Btu/hr

Fan motors, two 5-hp units per floor, represent a heat gain:

10 hp × 2544 Btu/hp-hr ÷ 0.85 motor eff
= 30,000 Btu/hr

Summary of total heat gain, *top, p 79,* shows that heat coming through glass, mainly solar radiation, is a small part (about 13%) of the total heat gain. Solar radiation is first absorbed by objects in the conditioned area. It doesn't appear as load on the cooling equipment until some time later. Resulting time lag means that heat gain and cooling load, at any instant, aren't necessarily equal.

But, since heat gained through glass is only a small part of our total gain, it's safe to assume that total heat gain is equal to the cooling load. Refrigeration tonnage per floor is therefore:

293,920 Btu/hr ÷ 12,000 Btu/hr/ton
= 24.5 tons/floor

Building volume survey, including lobby, shows that the air-conditioning system must be designed for the equivalent of 28 floors, calling for a total refrigeration plant capacity of 700 tons.

System selection, in an existing building, means tackling a host of problems that don't exist in new buildings—space

allowance, existing equipment, other renovations that can conveniently be done while installing air conditioning, inconvenience to tenants, etc. In most commercial structures, contractors install equipment during business hours. So we would be smart to choose a system that needs relatively little cutting through walls and floors.

Since cooling load is mainly due to heat gains that vary only slightly with time, a single-zone air distribution system can be used.

Shaft space, needed for big ductwork, isn't available, so each floor must have its own air-handling system. Chilled water comes from a central area. Air-conditioning engineers call this setup *vertical zoning.*

Return air. We have figured 1500 cfm outside air for ventilation. But this isn't part of the space load since its heat and water vapor are taken out before it reaches conditioned area. Biggest portion of air is return or recirculated air. And we design distribution system for it. To find recirculated air we first figure the enthalpy-humidity difference ratio from *ASHAE Guide, p 315:*

(Space sensible load + Space latent load) ÷ Space latent load/1076

= (216,510 + 27,760) (1076) ÷ 27,760

= 9475 enthalpy-humidity difference ratio

Plotting this figure on ASHAE Psychrometric Chart, *page 80,* we get 56.3-F apparatus dew point. From this data and formula on *p 316, ASHAE Guide,* recirculated air, cfm, is:

Space sensible load/(1 – bypass factor) ÷ 1.08 (space dry-bulb temp – apparatus dew point) =

$$\frac{216{,}510/0.9}{1.08(78-56.3)} = 10{,}250 \text{ cfm per floor}$$

We design air-distribution system for this air flow. Large fan and ductwork needed to pass air presents a space problem in existing buildings. It may be to our advantage, although more expensive at first, to install two smaller air-handling systems per floor.

Be sure to locate fan room as close to conditioned area as possible, to minimize ductwork. Chances are, final location will be a compromise.

Building we're considering has hung ceilings. We can use ceiling outlets exclusively — running our ductwork above the ceiling.

Refrigeration plant. Next step is to choose refrigerating machines. Heat gain figures showed that building requires 700 tons. Two centrifugal compressors, driven by wound-rotor variable-speed motors, allow part-load operation and provide standby in case of failure. Using two smaller units instead of one large one also eases delivery since most existing buildings don't have entrances big enough to accommodate 700-ton machines.

Objectionable noise, vibration, ease of maintenance and installation make the basement a logical refrigerating-plant area. And the machine subfoundation can rest directly on bed rock. Vibrations aren't transmitted to building steel.

Decision to use vertical zoning means that we'll need two circulating systems. Chilled water, from chillers in refrigerating plant, fans out through risers to air-handling-unit coils in conditioned areas. Second water system, used to condense refrigerant gas, carries water from refrigeration condensers in basement to cooling towers on roof. Each system uses two pumps. Spare pump can be switched from chilled water to condensing water by operating valves. See sketch, *page 78.*

Cooling tower choice for an existing building depends, in large measure, on its weight. Often, this factor becomes more important than tower type or construction. Before selecting the tower we must find loading capacity of building columns. If standard-design cooling tower overloads columns, we have two alternatives: (1) find a way to reduce cooling-tower weight and (2) reinforce building columns—a costly job.

Using lightweight materials such as aluminum, decreasing water level in cooling-tower sump and using tubular sections for structural uprights in the tower, are common techniques that trim cooling-tower weight. Don't forget to include weight of water in sump, and wind load in figuring load on existing columns.

Tower fans are picked on the basis of 300-cfm air per ton of refrigeration. With 700 tons, we'll need 210,000-cfm capacity.

Cooling-tower water circuit is sized to handle 30 gallon-degrees per-minute-per-ton of refrigeration. So if we circulate 3-gpm per ton, condensing-water temperature range is 10 F and total rated flow is 2100 gpm.

Drives and controls. Two possible compressor drives are steam-turbine and motor. Final choice depends on availability, investment, operating costs and operating ease. Common method of driving centrifugal compressors on ac power is by wound-rotor variable-speed motors, offering a direct way to control capacity. Since available speeds of wound-rotor motors are limited, capacity control can be supplemented with an automatic throttling valve at the compressor suction.

Although turbine drives, with their infinitely variable speeds, are well suited to direct capacity control, they need extra cooling-tower capacity for steam condensers. Also, existing boilers are 1-p units, generating steam at 10-psig. Additional boiler capacity needed for turbine drives also favors electric motor use in this case.

Our survey shows that existing main electrical-service lines to building can't carry motor load. We're going to install new 5000-amp service to feed refrigerating equipment and air-handling units as well as some old dc units being converted to ac.

Heating. Big difference between air conditioning existing buildings and new buildings is method of heating. In new structures we incorporate heating and air-conditioning systems in a single package. In our typical building, heating remains an independent system, although we'd do well to at least consider the possibility of taking out or modifying the existing heating system.

When these systems remain separate we face two tricky problems: (1) How should we introduce tempered air during winter for ventilation? (2) How should we control the existing heating system to keep inside temperatures from getting too high? Most common way to temper outside air is with steam coils in air-handling units. But it's a costly operation since we'd need new steam risers throughout the building. In an unzoned system like the one we're considering, it's possible to circulate hot water through the chilled-water coils, raising outside-air temperature to the right level.

To do the job we could install a steam-to-water converter, operating on 10-psig supply steam. Unit, located in sub-basement, heats water to 140 F. Outdoor thermostat controls discharge-water temperature. Also, new automatic modulating steam valves, in existing steam mains in sub-basement, respond to outdoor thermostat, help control space conditions.

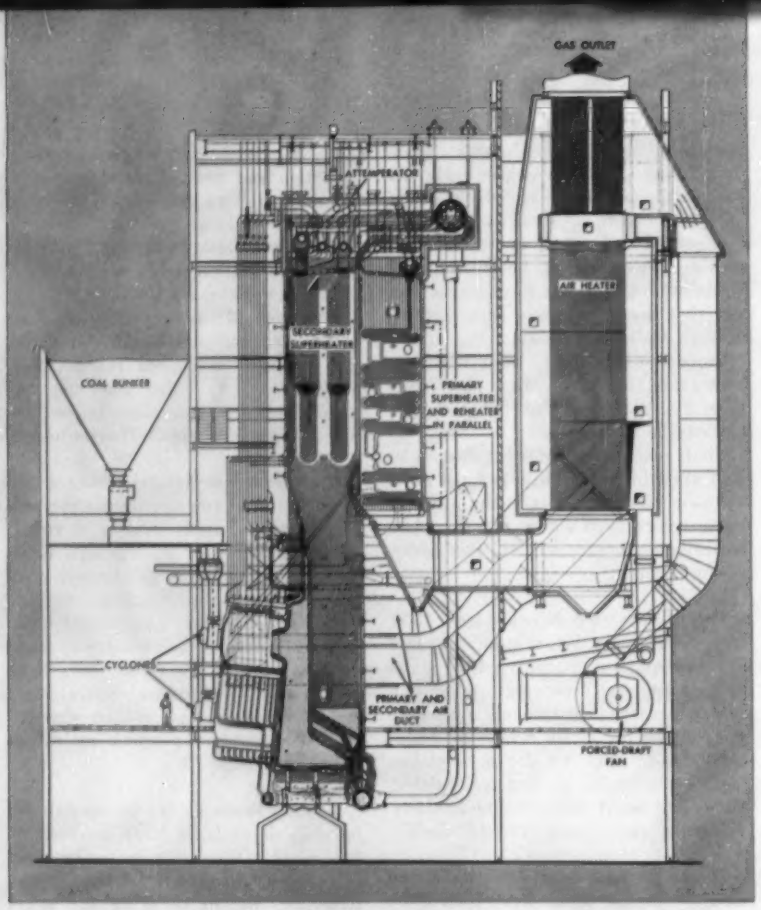
Pneumatic system controls entire air conditioning. Control components include min and max outside-air dampers, return-air dampers and three-way mixing-water valves. Controls keep air temperature leaving air-handling units at desired level during summer and winter cycles. Between seasons controls allow cooling with outside air only—boosting over-all operating economy.

FIRST OF TWO ARTICLES

By **ARTHUR J FIEHN**
Mechanical Engineer

AMBROSE J GEGAN, JR
Project Engineer

THOMAS L R WILLIAMSON
Staff Engineer—Instruments
Burns and Roe, Inc



1 Steam generator with four 9-ft-dia cyclone furnaces produces 990,000 lb per hr of 2050 psig 1050-F steam and reheats 740,000 lb 430-psig steam to 1000 F

Plan operations—then choose controls

Raritan River Plant extension, Jersey Central Power & Light Company, planned to be run by three operators

Central control room supplemented by local control boards near main equipment

This first part of 2-part article describes central control-room arrangement

► ALL EQUIPMENT of power plants in high-fuel-cost areas must contribute toward generating economical electric power. Designing a central-control system to best use the number of operators needed also helps operating economy. These aims formed the basis for designing the instrument and control system of the 1954 extension of the Raritan River Plant of the Jersey Central Power & Light Company.

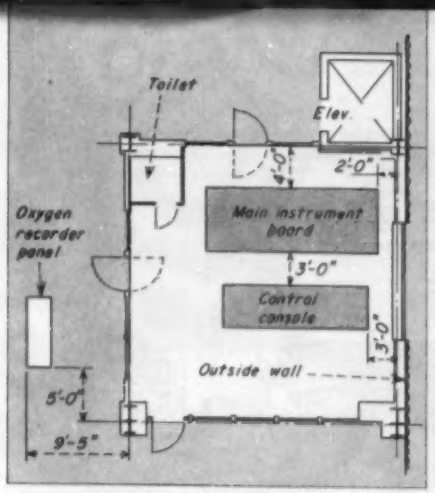
Equipment. This 125,000-kw unit has a Babcock & Wilcox cyclone-fired pressurized steam generator feeding a General Electric reheat tandem-compound triple-flow condensing turbine supported on its main condenser.

Fig. 1 shows the steam generator and its cyclone furnace elements. The turbine takes main steam at 2000 psig, 1050 F and reheat steam at 430 psig, 1000 F. The boiler fired by four 9-ft-dia cyclone furnaces delivers 900,000 lb per hr of main steam and 740,000 lb per hr of reheated steam.

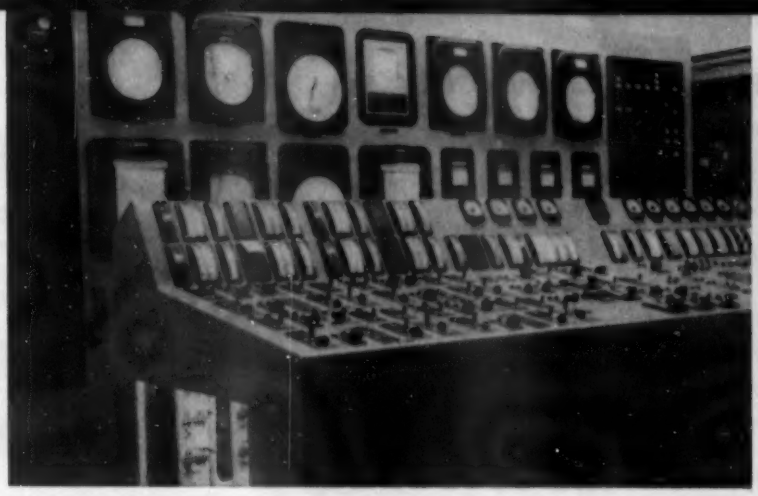
The boiler is designed to burn coal and gas in any combination, in any or all cyclones. Design anticipates oil as a third fuel in the future.

Operators. As a design basis for the control system of the new unit, it was decided that three men under the direction of the existing plant supervisors, plus the participation of the existing switchboard operator, could run the unit. A centrally-located switchboard room overlooks the enlarged turbine room. The operator in this room does the switching and loading of the turbine generators.

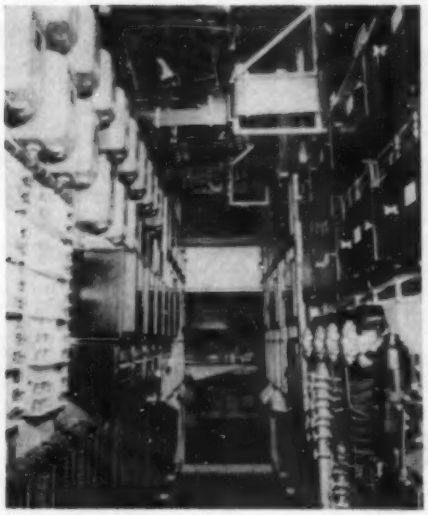
Of the three full-time operators, one mans the central-control room, another



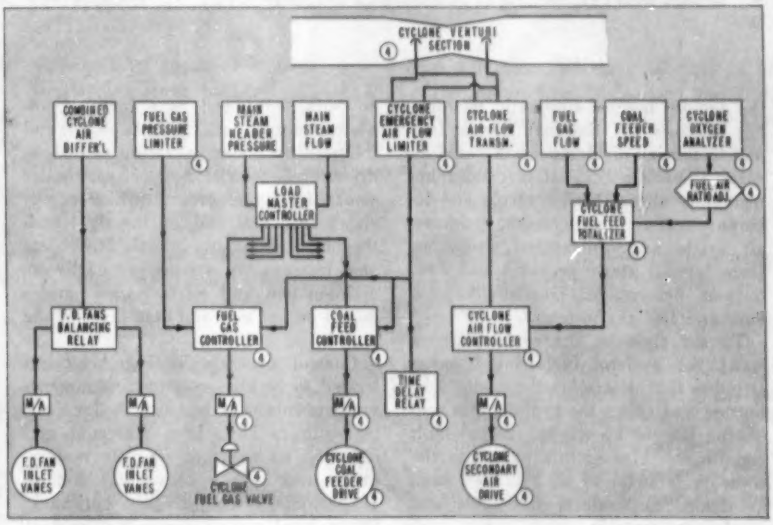
2 The control room for 125-mw unit is manned by one operator for full time



3 Benchboard in control room carries all controls and miniature indicators while vertical panel in back holds annunciators, soot-blower controls, and recorders



4 Benchboard for control room was prefabricated, extends to the floor below



5 Electrical combustion-control system regulates four cyclone furnaces in parallel and maintains proper proportion of the pulverized-coal and natural-gas fuels

operates plant equipment in the basement, and the third acts as roving operator in addition to his routine duties. The shift operator, a working foreman, assists in bringing the new unit on and off the line and relieves an operator when necessary. With few exceptions all equipment stands on the operating and basement levels of the plant extension.

Centralized-control rooms have been controversial — some accept them "whole hog," some with reservations, and others see no merit at all. Our firm develops an operating plan with the utility aiming to economically employ the personnel assigned. The control and instrument arrangement must fit the needs of such a plan.

The plant can't be run by one man in a central-control room. Auxiliary equipment must serve the main cycle. Several men must participate and they can't do it "flying blind" with all instrument "upstairs in a central-control room."

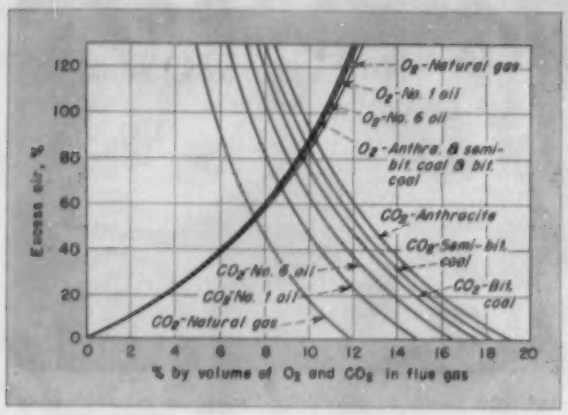
Central-control room for the new unit stands on the operating floor with full view of boiler and turbine-generator. Local control and instrument panels in the basement help the operator to run the equipment there. But the control room has enough instruments to show the operating status of these auxiliaries.

Systems controlled from the basement include: (1) demineralizer plant (2) boiler-water treatment (3) ash-handling system (4) turbine-oil purification (5) generator H_2 and seal-oil system. The central-control room runs the other basement equipment.

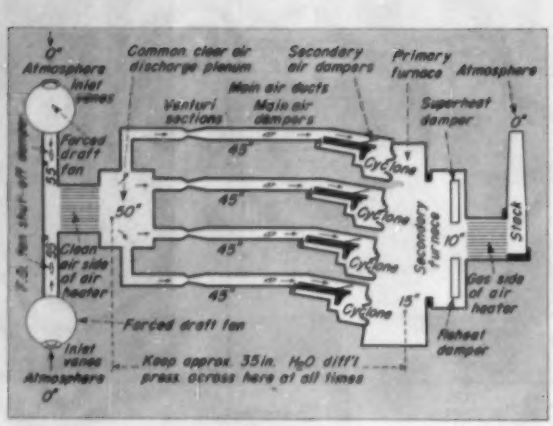
Fig. 2 and 3 show the arrangement of the centralized-control room for one-man operation. The operating console (benchboard) contains the most important indicating instruments and all the operating controls. Theoretically the operator can run the unit entirely from the console. Experience has shown us, however, that operators make considerable use of recorders because trends can't be easily detected from indicating instruments alone.

Since there was no room for even miniature recorders on the console, we mounted standard-sized recorders on the vertical panel directly behind it.

Console layout. Controls for the four cyclone burners occupy the left side of the console. These consist of: ignition lightoff switches, manual-automatic selectors for the various fuel feeds, fuel-air ratio adjustment, and



6 Oxygen analysis makes a better index of combustion efficiency than CO_2 because of independence of fuel analysis



7 Combustion-air circuit for steam generator powered by two forced-draft blowers must keep given pressure difference

the remote manual-automatic positioning controls for the main, secondary and tempering air dampers. Related individual cyclone indications stand immediately above these controls and include: coal-air temperature, primary-air static and differential pressures, secondary-air static pressure and flow, oxygen percentage, ignition-oil pressure and fuel-gas pressure.

To the right of the cyclone group stand the cyclone fuel-firing selector switches that determine the fuels to be burned and select the cyclone that will be the last to be tripped under fault conditions. Also at this point are the controls common to all cyclones, such as steam temperature, feedwater and condensate controls.

Electrical switches for the boiler feed pumps, condensate pumps and turbine lubricating-oil pumps are arranged in a graphic panel on the console right-hand side showing boiler, turbine, condenser and feedwater heaters. Appropriate indicators stand above each control. Recorders on the vertical panel are arranged in an order similar to that on the console. In general, the operator can see the results of his adjustments without moving from the control station. This logical grouping aids speedy identification under emergency conditions.

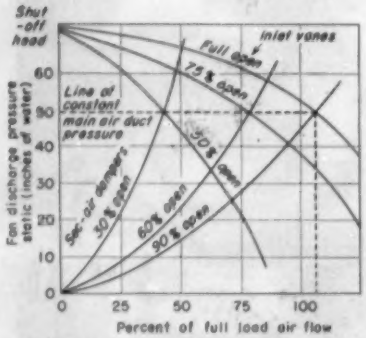
Compact arrangement of these elements raises problems of accessibility for mounting, wiring, tubing and servicing. These have been solved by removable panels on rear and sides and by extending the console some six feet below the control-room floor. Fig. 4 shows the lower part of the console interior, entered from the floor below.

Vertical instrument board, of fully-enclosed tunnel type, has access doors on each end and instruments mounted on both front and rear faces. Soot-blower control panel mounts on left end followed by boiler operating recorders, drum-level television receiver, boiler smoke-density recorder, turbine supervisory recorders and, on the right end, the unit annunciator panel. Recorders and instruments serving primarily as maintenance and performance guides mount on the side and rear faces of the board.

Control centralizing has been extended to locally mounted instruments and controls. For instance, boiler draft transmitters have been collected and mounted on racks to simplify maintenance and have a convenient method of periodic compressed-air blowback. Other local panels group transmitters for steam generating auxiliaries, cyclone oxygen analyzers and generator hydrogen-purification equipment.

Impulse transmission. The unit uses both pneumatically and electrically actuated control systems. The steam-temperature, feedwater and condensate control systems are pneumatically actuated while the combustion control system uses electrical impulses. Where important variables are both indicated and recorded, the indicator will often be electrically actuated and the recorder pneumatically, or vice versa. Upon failure of an automatic controller, the operator will have manual control and either an indicator or recorder to guide him.

With this arrangement the possibility of unit shutdown because of individual instrument failure has been minimized. For additional reliability the instrument compressed-air system is backed up in emergencies by, first, the station-service air system, and second, the soot-blower compressed air system. Two separate buses tied to the station-service transformer supply power for the electrical instruments.

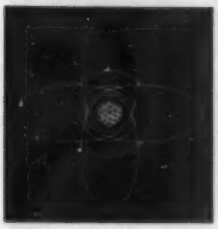


8 Inlet air vanes and secondary air dampers must be adjusted at same time to hold cyclone air differential

An integrated multiconductor armored-tube system carries the pneumatic instrument lines. Previous projects have shown that it gives a neat and economical installation although the material cost is somewhat higher than conventional instrument tubing laid in trays and racks.

Combustion control. Fig. 5 shows a block diagram of the Hays electrical combustion control. Main steam-header pressure and main steam flow combined determine the rate of fuel feed to all cyclones running. Rate of fuel feed determines air flow to each individual cyclone. In this sense it is a *series* rather than a *parallel* arrangement. Since the whole system is electrical and the combined fuel rate for each cyclone is computed before burning the fuel, there is virtually no lag between fuel

(*Continued on page* 180)



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Over 5,000,000 kwhr of electricity have been generated by the first two atomic submarine power plants built by Westinghouse Electric Corp. The first plant (Mark I) went into operation on the Idaho desert on May 31, 1953. The Nautilus, powered by the second atomic plant (Mark II) went to sea January 17, 1955. Mark I continues to be put through extensive testing program. This information will help to design better future reactors. Westinghouse now works on three new atomic marine plants—one for Navy surface ship, two for submarines.

World's most radioactive piece of material now works at atomic radiation laboratory of the Esso Research Center in Linden, N.J. This cobalt metal pipe, 13-in. long and 2-in. dia, was bombarded for more than 2½ years in the Brookhaven atomic reactor. The pipe produces about 3500 curies of gamma rays. (World supply of refined radium produces about 2400 curies.) Esso Lab seeks ways of making better gasolines, oils, petrochemicals and oil products.

British 10-year atomic power program has six more plants added to the 12 originally projected. Reactors will produce fissile material for both military and civil use. Building of first plant, Calder Hall, started in 1953 will run by end of 1956.

Division of Civilian Application in AEC staff will be headed by Harold L Price. It develops regulations and instructions for licenses, authorizations, and other activities related to civilian use; administers AEC licensing program; prices materials and services to licensees and materials bought from them; authorizes distribution of source, special nuclear and byproduct materials; administers access to restricted data for civilian use; deals with authorizations to export equipment and materials and engage in activities outside of USA.

Government's atomic energy program has been created over past 12 years; 12- to 14-billion dollars have been invested in it. We spend about 2-billion dollars a year to run it, equivalent to $250,000 every hour, every day.

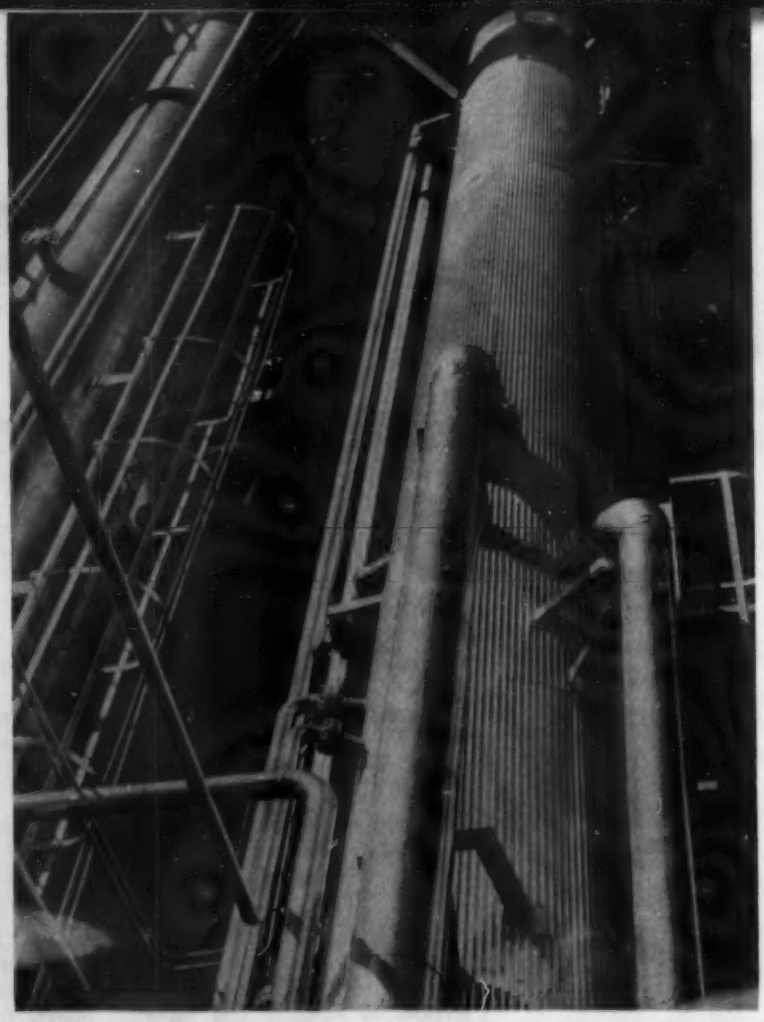
Radioactive isotopes find many jobs in industry. Typical applications include: Controlling thickness of strip material in rolling mills; discharging static electricity in textile operations; oil prospecting; fluid flow control in pipelines; detecting leaks in water mains; detecting liquid level in closed systems; testing filter efficiency; measuring wear in test engines; checking efficiency of industrial mixing processes; checking migration of constituents in paper manufacture; measuring plant nutrients in soil and uptake of fertilizer, many others.

AEC pays $400,000 to four scientists for all rights, title and interest in certain inventions in plutonium separation processes. This work had been done in 1940-1941 at the University of California, before they engaged in research work on Government contracts. These men are: Dr Glenn T Seaborg, professor of chemistry, University of California; Dr Joseph W Kennedy, head of chemistry dept, Washington University; Dr Arthur C Wahl, professor of chemistry, Washington University; Dr Emilio G Segre, professor of physics, University of California.

Nuclear Engineering and Science Congress in Cleveland, Ohio, Dec 12-16, 1955 will present nearly 300 papers in 50 sessions. Concurrent Atomic Exposition will show equipment and models of leading U.S. and foreign industrial firms.

By D G LaRUE, *Mgr, West Coast branch*
Product Development Department
Kaiser Aluminum & Chemical Corp

Protecting insulation from the weather can cause real headaches unless you have suitable materials for the job. Here are details on a covering that finds many uses in power, petroleum, chemical and other plants



CORRUGATED-ALUMINUM SHEET on this tower has horizontal lapping, prevents moisture entering during rain, snow, dew. Note spun-aluminum elbows on tower pipes

Easy-to-use aluminum weatherproof

► NOT ONLY does aluminum weatherproof covering keep insulation dry, but it also has these advantages for pipes, tanks and containers: (1) competitive in cost with conventional coverings (2) comparatively maintenance-free (3) easier to install (4) readily removed and replaced (5) capable of producing higher strength than insulation alone and (6) fire-resistant—nonflammable. It also has inherent light weight, high solar reflectivity, attractive appearance and freedom from red rust.

Purposes. Aluminum covering serves two purposes: weatherproofing the moisture-absorbing porous insulating filler and protecting the fragile insulation from mechanical damage. For best results, follow the manufacturer's recommendations for type and alloy of sheet used and for installation methods.

Uses. Flat sheet is generally selected for covering insulated pipelines; corrugated-aluminum roofing is best for covering large storage tanks and pressure vessels. Two grades of aluminum sheet are recommended for covering, depending on corrosiveness of atmosphere.

The first of these, known as utility sheet, is well-proven as satisfactory for ordinary conditions. But where covering is exposed to severe industrial or marine atmosphere, aluminum alloy 5050-H34 is best.

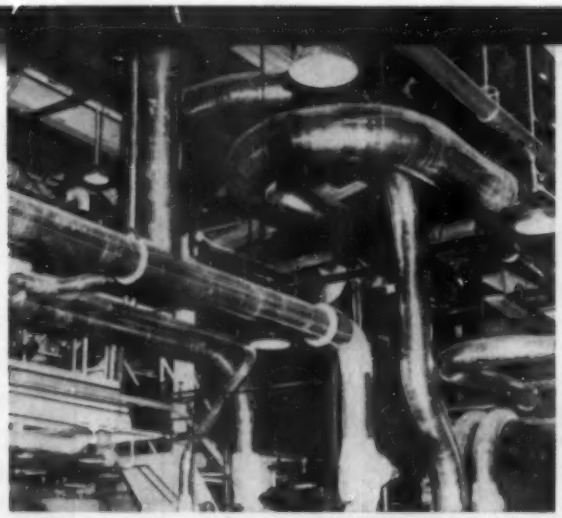
When aluminum covering is properly applied over completely dry insulating material, and the covering is weathertight, there is no internal corrosion problem provided leakage from tank or pipe is prevented. Where it is impossible to insure complete dryness of insulating material before covering installation, the filler may be wrapped with a single layer of 15-lb asphalt-impregnated roofing felt, or one heavy coat of bituminous enamel may be applied to the inner surface of the aluminum covering.

When high-moisture content cement is applied to the pipe, allow ample time for the material to dry completely before the covering is installed.

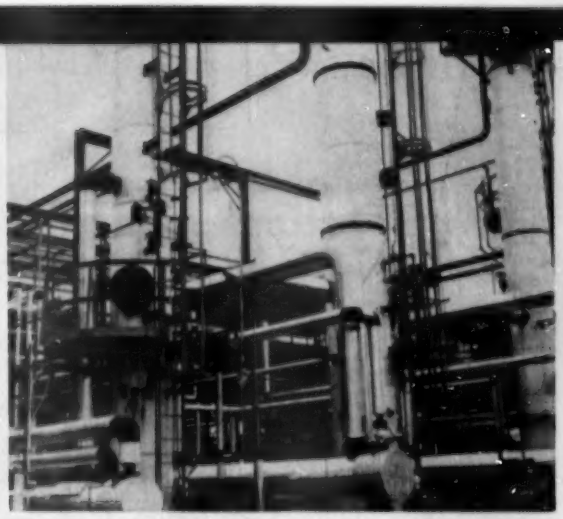
Pipe covering comes in 36-in. wide sheets in coil form. Recommended thicknesses are:

Pipe dia, in.	*Sheet thickness, in.*
6 or under	0.016
6 to 12	.020
12 to 24	.024

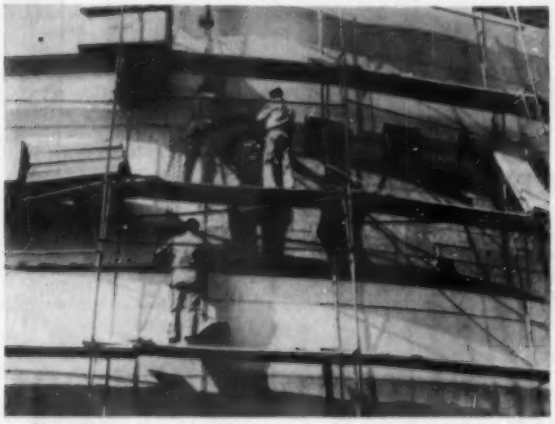
Sheet is applied on the site in coil



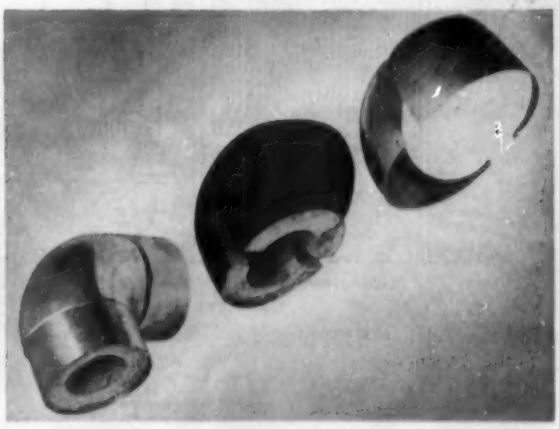
FLAT-ALUMINUM SHEET on insulated plant-piping is used here with ease on long-radius bends, Ts and other pipe fittings



OUTDOOR APPLICATION of flat- and corrugated-aluminum weatherproofing on process pipes, towers of various diameters



INSTALLATION METHOD for corrugated-aluminum sheet on a hot oil storage tank. T section and clip angles support sheet



COMPONENTS of an aluminum-covered elbow fabricated by spinning. Simple self-tapping screws hold the covering in place

covering keeps heat insulation dry

form, using a portable arbor to speed unrolling. Hand-operated sheet-metal shear is used to cut the aluminum. It is formed into tubular shape on a hand-operated 3-roll former.

Tubular aluminum section is then snapped into place over the pipe insulation. Longitudinal lap joints are secured with No. 7 flathead self-tapping 2024 anodized aluminum alloy sheet-metal screws. Stainless-steel screws may also be used, but those of cadmium-plated steel are not recommended. Other screws should be spaced not more than 8 and preferably 6 in. apart.

On vertical pipe runs, covering should be installed from bottom up, to insure moisture drains away from end lap joints. In horizontal runs, lengthwise lap joints should be on the under side of the pipe at the 4 or 8 o'clock position to obtain proper drainage away from the joint.

Straps may be used instead of screws. For pipes under 36-in. diameter, straps should be ¾ in. wide, 0.020 in. 5050-H34 bands. For the larger sizes, expansion-type stainless-steel bands are recommended.

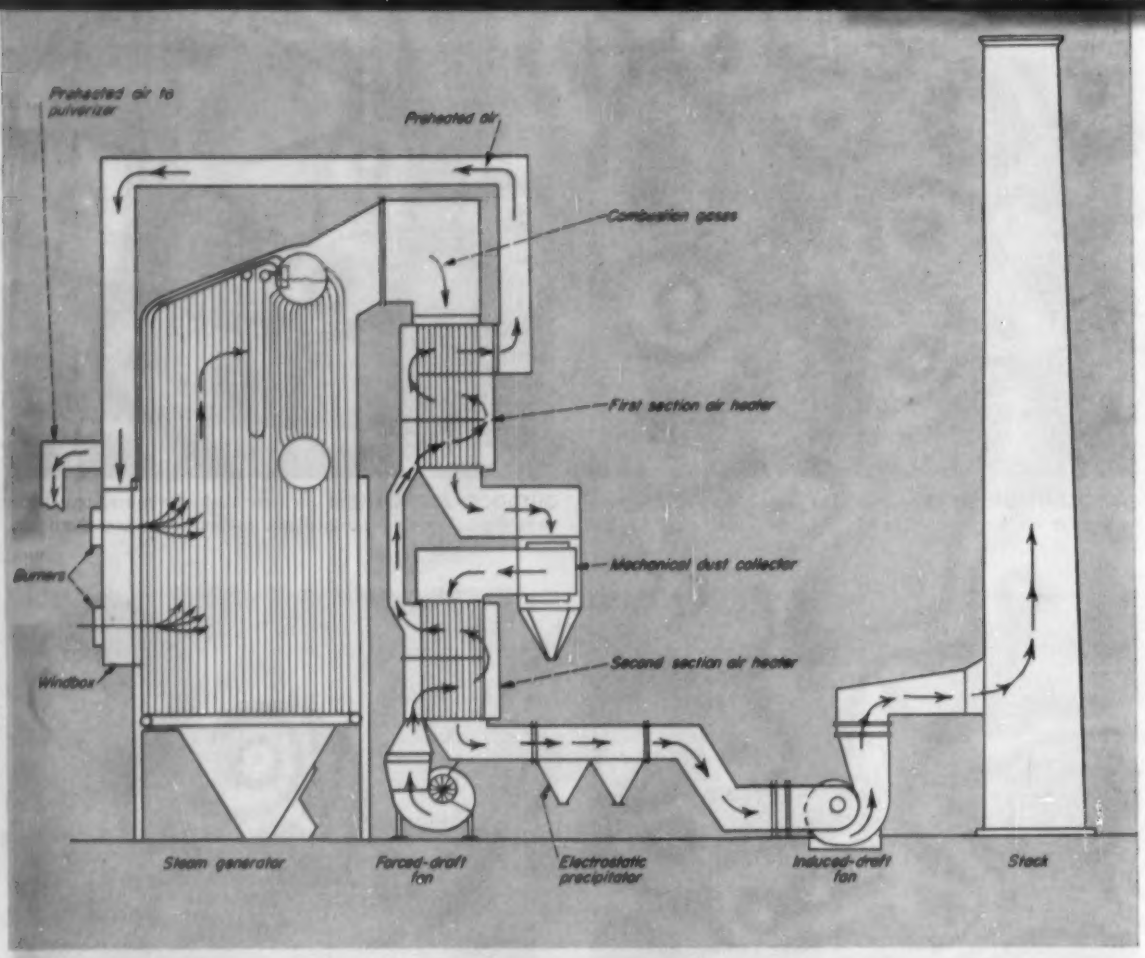
Fittings. Spun-aluminum elbows are available for fittings. Expansion sections, T fittings and long-radius elbows, over 12 in. in diameter, are easily fashioned from sheet aluminum.

Tank covering. Almost any size tank can be covered economically with aluminum over the insulation. Scaffolding is simple because the materials are lightweight.

Tank is primed with dichromate and coated with aluminum paint. Horizontal supporting Ts or angles are attached to the tank, with spacing ranging from 12 to 24 ft, depending on tank height. Supports hold two tiers of corrugated-aluminum sheet.

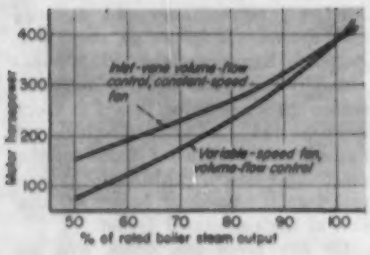
Longitudinal seams are lapped at least 1.5 corrugations and fastened with sheet-metal screws on about 8-in. centers. Expansion-type steel bands normally secure the jacket and are vertically spaced no more than 4 ft apart. Nozzles and similar projections are flashed with .020-in. flat-aluminum sheet and packed with high-temperature insulating cement before installation of the corrugated jacket.

On any given job, check with the manufacturer to obtain his exact recommendations for installation.



Matching a draft system to your boiler depends on . . .

Figuring design conditions for f-d, i-d fans



HORSEPOWER needed for variable-speed and constant-speed volume-flow controls

► We viewed the basic elements of draft-fan selection in May Power, pp 88-91. Now we're ready to work out an actual case study. We'll figure fan-design conditions for a typical steam power plant.

Basic data. Draft system we'll select serves an oil- and pulverized-coal-fired boiler rated at 325,000 lb per hr, 900 psig, 900 F. Air flow needed for combustion is 365,000 lb per hr (from combustion calculations). Allowing 11,000 lb per hr (3% of required combustion air) for external leakage loss between f-d fan outlets and windbox, 376,000-lb air per hr enters f-d fans.

Table V shows how to find flue gas entering i-d fans, based on air flow, fuel flow and infiltration allowances. Flue gas, 422,000 lb per hr, enters i-d fans.

Air, gas volumes. Assuming no heat loss between air-heater outlet and i-d fan inlet, flue-gas temperature leaving air heater and entering i-d fan is 315 F. Air temperature at f-d fan is 100 F. With these temperatures, and pressure losses through f-d and i-d system, Table

V*: Air and flue-gas weight-flow data at 325,000 lb-per-hr steam output, 900 psig, 900 F. For pulverized-coal firing

	Lb per hr
Air entering f-d fans	376,000**
Air needed for combustion	365,000
Coal used, less 10% for ash allowance	25,700
Air plus ash-free fuel used	390,700
Allowance for air infiltration to boiler	15,600
Flue gas leaving boiler	406,300
Allowance for air infiltration to gas side of tubular air heater	6,300
Flue gas leaving tubular air heater	412,600
Allowance for air infiltration to duct system and mechanical dust collector	9,400
Flue gas entering i-d fans	422,000

*Tables I-IV appear in May '55 *Power*, pages 90-91.
**Assumes total air required for combustion is delivered by f-d fan.

VI: Pressure loss in f-d, i-d system, boiler, superheater passes. Also furnace draft and windbox pressure at rated boiler output

1. F-d system losses and requirements	In. wg
Pressure at burner windbox	3.60
Pressure loss through air heater	2.80
Pressure loss through ducts, flow-control vanes	1.00
Static pressure needed at f-d fan discharge	7.40
2. I-d system losses and requirements	
Furnace draft needed	0.10
Pressure loss through boiler, superheater passes	3.00
Pressure loss through air heater	3.00
Pressure loss through mechanical dust collector	2.50
Pressure loss through ducts, flow-control vanes	1.00
Static draft at i-d fan inlet	9.60*

*Based on stack's natural draft supplying pressure head to meet stack velocity and pressure-drop requirement. Where stack-pressure loss and stack-exit velocity are high, i-d fans may have to supply additional pressure. If a stack venturi is used (because of stack-height limitations or local atmospheric conditions) to get high exit velocities, i-d-fan pressure load would be subject to further increase.

Controlling factor in determining gas velocity leaving stack is flue gas dispersion into atmosphere. Dispersion is based on local conditions, fuel burned, effectiveness of dust collectors for solid fuels, etc.

VII: System pressure, volume design conditions. % margins from Tables I and II, May Power

Volume

	At rated boiler load, cfm	% margin	Design condition, cfm
F-d	88,500	20	106,200
I-d	141,000	20	173,000

Static pressure at fan discharge

	At rated boiler load, in. wg	% margin	Design condition, in. wg
F-d	7.40	44	10.65

Static draft at fan inlet

	At rated boiler load, in. wg	% margin	Design condition, in. wg
I-d	9.60	44	13.82

VIII: Part load (66%) air, flue-gas weight-flow data. Air entering f-d fans: 100 F. Flue-gas entering i-d fans: 285 F

	Lb per hr
Steam generated	214,000
Air entering f-d fans	261,000*
Air needed for combustion	250,000
Coal used, less 10% for ash allowance	17,000
Allowance for air infiltration to boiler, air heater, ducts and dust collector	31,300*
Flue gas entering i-d fans	298,300

*Allowance for leakage and infiltration assumed constant over load range for calculating purposes.

SECOND OF TWO ARTICLES

By GEORGE A EATON and ROBERT H SHANNON
United Engineers and Constructors Inc

VI, we can convert air and flue-gas weight flow to volume flow. From ideal-gas law:

$pv = WRT$ (1)

$v = WRT/p$

For flue gas entering i-d fans:

p = absolute press., lb/sq ft
= (14.7) (144) – (9.6/12) (62.4)
= 2065 lb per sq ft

T = abs temp, Rankine
= 460 + 315
= 775 Rankine

R = air or gas constant
= 53.3 ft-lb per lb-deg Rankine.

While this is the air constant, max variation for flue gas is only plus 5% to minus 8%, for different fuels and varying excess air.

W = air or flue-gas flow, lb per min
= 422,000/60 = 7050 lb per min

$v = WRT/p$
= (7050) (53.3) (775)/2065
= 141,000 cfm flue gas entering i-d fans

Figuring air flow to f-d fans, using method above, we get 88,500 cfm.

Design conditions. To find fan-design pressure, volume, apply percent margins from Tables I, II (May Power, pages 90-91). Multiply these margins by pressure, volume flow at rated boiler load. Results, Table VII, are part of info fan supplier needs, to propose right fan for your job.

For this 325,000-lb-per-hr boiler we can justify two fans in each draft system. Also, gain in flexibility and reliability make two fans per system a sound choice. Design conditions for each f-d fan are thus: 53,000 cfm, 10.7-in.-wg static pressure at fan discharge.

(More on next page)

IX: Part load (66%) pressure, volume operating conditions for f-d and i-d fans

Steam generated, lb per hr	214,000
Air entering f-d fans, cfm	61,000*
Static press. at f-d fan discharge, in. wg	3.50
Flue gas entering i-d fans, cfm	93,000*
Static draft at i-d fan inlet, in. wg	4.10

*Air, flue-gas volume flows figured from ideal-gas law, using same method as shown for rated-load volume flows.

XI: Annual power saving: variable-speed flow control over inlet-vane flow control

Expected boiler loading			Annual savings		
Steam load, lb per hr	% load	Hr per year	Per fan, Hp	Per fan, Hphr	Two fans, Hphr
325,000	100	3000	0	——	——
250,000	77	3000	45	135,000	270,000
175,000	54	2000	75	150,000	300,000

Estimated total annual saving = 570,000 hphr

Based on 4.0 mills per hphr power cost, annual dollar saving is $2280.00.

X: Comparison of fan-design conditions with part-load operation using 1 fan per system

	Volume, cfm		Pressure, in. wg		Draft, in. wg	
	Design conditions	66% load	Design conditions	66% load	Design conditions	66% load
Fd	53,000	61,000	10.70	3.50	——	——
I-d	87,000	93,000	——	——	13.80	4.10

XII: Installed costs of i-d fans and motors using inlet-vane and variable-speed flow controls, for fan-design conditions in Table X

Equipment	Estimated installed cost	Cost increase over inlet-vane method
Two i-d fans, motors, inlet vanes	$40,000	——
Two i-d fans, motors, magnetic couplings, controls	$60,000*	$20,000
Two i-d fans, wound-rotor motors, liquid rheostats	$60,000*	$20,000
Two i-d fans, motors, hydraulic couplings, controls	$68,000*	$28,000

*Based on data from table IV, May Power, page 91.

To choose between constant-speed and variable-speed controls, compare initial cost with operating savings

For each i-d fan: 87,000 cfm, 13.8-in.-wg static draft at fan inlet.

Part load. With two fans selected for each draft system, let's find out if we can carry 66% of rated boiler load with one fan out of service in either f-d or i-d systems. Table VIII lists air, flue-gas weight flows for 214,000-lb-per-hr steaming rate. Next, convert weight flow to volume flow—just apply ideal-gas law in same way as for rated load conditions. Table IX gives results.

To figure part-load pressure losses in system, we make use of an approximate formula: Resistance to air or flue-gas flow varies in proportion to the ratio of air or flue-gas volumes squared:

$$P_2/P_1 = (V_2/V_1)^2 \qquad (2)$$

P_1 = pressure loss at rated boiler load, in. wg

V_1 = volume flow at rated boiler load, cfm

P_2 = pressure loss at part load, in. wg

V_2 = volume flow at part load, cfm

For f-d system:

$P_2 = (61{,}000/88{,}500)^2 (7.40)$

$= 3.50$ in. wg

Using same formula for i-d system, part-load i-d pressure loss is 4.10 in. wg. Results are tabulated in Table IX. Comparing part-load operating conditions with fan-design conditions, Table X, it looks as though 66% boiler load can be carried without damage to fans or motors. But this must be checked against fan-performance data and characteristic curves for the fan actually bought.

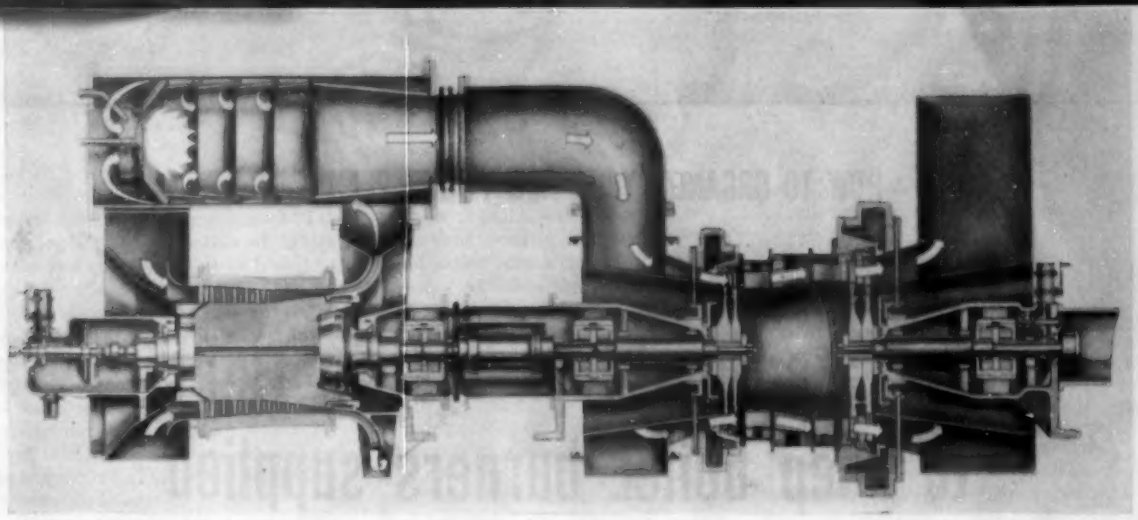
Fan controls. Variable-speed flow controls show a $2280 annual power saving, Table XI. Horsepower savings in this table represent difference between the two curves in graph shown on page 88.

Assuming that any capital investment carries a 15% fixed-charge rate—covering interest, dividends, insurance, taxes and amortization—we figure additional dollars that can be spent on variable-speed flow controls:

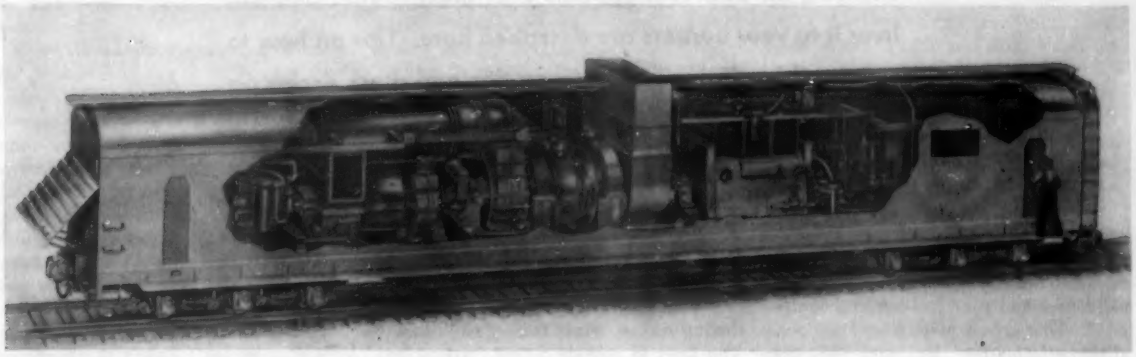
$$\$2280/0.15 = \$15{,}400$$

Since increase in installed costs, Table XII, of variable-speed fans and control equipment exceeds $15,800, we'll choose inlet-vane flow controls. Also, maintenance on inlet-vane controls is expected to be lower than for the variable-speed types.

Horsepower needs. Lowest possible air, flue-gas temperatures fix weight flow on which fan loading and horsepower needs are based. So, after figuring 53,000-cfm air and 87,000-cfm flue-gas design volume flows, apply the ideal gas law at 50 F for f-d system and 250 F for i-d system to get maximum design weight flows. Results are 249,000-lb-per-hr air, and 284,000-lb-per-hr flue gas.



Dual-shaft simple-cycle gas turbine drives...



Rail-car mounted mobile power plant

► ON JULY 7TH, Clark Bros. Co of Olean, N. Y., demonstrated its 5500-kw mobile power plant before editors of the technical press. Putting the unit through its paces on a test bed, the builders showed us how it could be run by a single operator. They claim the plant can be running within 24 hrs after its arrival at any generating site. Connections need be made only for fuel and for electrical power delivery.

All cooling depends on air flow, eliminating need for water. Making the unit ready to run includes such chores as unclamping rotor elements, lowering extendable car sides to expose air-filter entrances, removing the cover over turbine exhaust.

Unit has been built for emergency service to specifications of the Bureau of Yards and Docks of the U. S. Navy. Heavy-duty design makes it possible to run unit continuously for any duration needed. The plant can be moved from one site to another at high speed as part of a freight or passenger train.

By B G A SKROTZKI,
Associate Editor

Compressor, combustor and h-p turbine make up the plant's gas-generator unit. The 2-stage turbine drives a 13-stage compressor at 5000 rpm. Normal turbine-inlet temperature runs at 1350 F but excess temperatures may be tolerated on the following schedule:

Gas temperature	*Operating time*
1375 F	100%
1400 F	25%
1425 F	5%
1450 F	1%

The three burners in the single combustion chamber will burn No. 2 diesel fuel oil. But residual fuels can be burned after making minor adjustments to pressure regulators and valving, and by limiting turbine inlet temperature to 1150 F. With this limitation, unit can generate only 3200 kw, but vanadium corrosion and ash-deposit fouling of blading will be avoided.

The axial-flow compressor develops a pressure ratio of 4.25:1 with a flow of 100 lb per sec. This low-pressure ratio for a simple-cycle unit was chosen to minimize the number of designs needed for gas turbines of this size. Loss of efficiency for intermittent emergency service is relatively unimportant, but this pressure ratio will be economical for a base-load high-efficiency regenerative-cycle plant running at 1350 F.

Long annular ducting between turbines makes it easy to get at turbine blades and disks for inspection and repairs, without disturbing the bearings. In addition, the gas-generator element rests on a separate bedplate from the l-p turbine and electric generator. Ducting forms a flexible connection between turbine passages that automatically allows for any misalignment between bedplates.

HOW TO ORGANIZE YOUR NEW POWER PLANT—16

Operate your fuel system right to keep boiler burners supplied

The gas, oil and coal systems that process fuel and deliver it to your burners are described here. Tips on how to spot troubles, figure fuel consumption and check excess air

By D C SWIFT, *Ebasco Services Incorporated*

► THE FUEL SYSTEM in your plant is the vital link between the outside supply source and your fuel-burning equipment. This article gives practical operating information for each of the common fuel types, except pulverized coal, which will be discussed next month. Here's how they are prepared for delivery to the burners and stokers discussed in January POWER, p 88.

GAS-FUEL SYSTEMS

With natural or coke-oven gas as the main boiler fuel, your chief concern, once the plant is on the line, is maintaining supply and burner pressure. Gas supplier controls this, but you must advise him if pressure falls in an unusual manner. If gas supply is interruptible, falling pressure may be the signal to get reserve oil burners ready for operation.

Gas-metering runs are usually installed in duplicate or triplicate. For accurate measurement, capacity must accord with the amount of gas flow. Permanent meters may also record heat content and specific gravity. Change the charts regularly at the same time each day.

Gas may be reduced to burner header supply pressure—usually 30 to 50 psig—in reducing valve stations. Check these stations regularly to see that (1) there is no excessive leakage, and (2) regulating valves work smoothly, providing a steady header supply pressure. High- and low-pressure alarms installed here warn of undesirable conditions.

For a very high pressure drop, reducing valves may freeze and stick. You need to provide means for heating them. You also need traps to drain condensation out of low spots in gas lines. Check these periodically to see that they work OK.

Gas burners operate properly between certain maximum and minimum pressures. For good burner action, cut burners in and out, as necessary, to stay within this range. A control valve, either manual or actuated by a combustion control, admits gas to the burner supply header according to steam demand and boiler pressure. Alarms may warn if burner pressure deviates from the proper pressure range. In some systems, if pressure falls below a safe minimum the alarm will shut a trip valve in the supply line.

When lighting off, use a torch or igniter for each burner. Check that burners already in service are not snuffed out by falling header pressure as each new one is cut in. Gas and air flow should divide equally between burners. To change flame shape and distance from burner adjust the registers and excess air. Keep on regulating until flame stabilizes and does not impinge heavily on adjacent furnace or waterwall surfaces.

Take orsat readings to check flue-gas composition and determine amount of excess air. See that sampling lines are free from leaks and located to obtain a representative sample.

With good air and gas mixing and even distribution between the burners, you can usually operate with 10% or less excess air. Setting must be tight to prevent infiltration of air that dilutes flue gas without benefiting combustion.

A small amount of secondary air is often used to keep idle burners below the heat damage point. This factor, plus poorer gas distribution when some burners are not in service, generally means higher excess air at light loads. Using upper burners helps increase superheat at lower loads.

OIL-FUEL SYSTEMS

Unless your steam plant is next to a refinery, fuel oil must be received and stored. In any case, it must be measured. Ships, barges, tank cars or tank trucks are generally calibrated volumetrically. Shipper's measurements can be checked at point of receipt. Make appropriate correction for volume changes if temperature differs from standard, usually 60 F. You can get tables of correction factors for various oil types.

Heavy fuel oils may require heating to flow satisfactorily. Check storage-tank levels whenever you add or remove oil to determine quantity on hand and oil use. Keep records of these values.

Calculate fuel consumed from records

of total oil on hand and amount received during the record period. Take samples for determination of heating value and other qualities as fuel is unloaded or burned.

In cold climates, you may have to use steam-tracer lines or other means of heating to keep oil from becoming too viscous. A heater at the suction line of each storage tank usually permits raising temperature to perhaps 100 F. Shut this heater off when oil is not to be transferred. This conserves heat and reduces sludging.

Open vents on the tanks prevent possible collapse if a vacuum forms as oil is removed. Be sure that vent is screened. This helps protect against fire and keeps insects and small animals out.

If oil is to be transferred with a pump, or if oil flows to the burner feed pump, do not heat it so much that it releases vapors. Pump might become vapor-bound. This is particularly important when suction operates below atmospheric pressure.

Fuel-oil pumps are mostly of the positive-displacement type. A relief or bypass valve protects the pump and discharge lines against excessive pressure if flow is restricted. These valves should be set carefully to relieve at the design pressure, and tried periodically to be sure they still operate properly. Steam or air-driven reciprocating pumps cannot ordinarily develop excessive pressures. Hence they do not need this protection.

If oil is heavy, burner supply-pump output passes through another heater to reduce viscosity to a point where it can be readily atomized. Steam is the usual heating medium. Keep pressure and temperature low to avoid over-heating and carbonizing oil close to the heater tube surfaces. Excessive oil temperature may also cause burner-tip carbon deposits.

You can use manual or automatic control of steam to the oil heater. To avoid excessive temperature swings, coordinate steam closely with oil use. In many fuel-oil systems, the full fuel-pump oil capacity circulates through the heater. Excess above burner needs returns to the oil-supply tank for reuse. This prevents wide variations in heat requirements in the oil heater.

Oil-supply system should be laid out so hot oil circulates right up to the burner shutoff valve. Then burners are always ready for service. Pressures up to 500 psig are used. You need a minimum of about 100 psig for good atomization with pressure-atomizing burners. Steam-atomizing units operate satisfactorily with much lower pressures.

In some systems, the burner-system relief valves operate to vary the header pressure and thus the firing rate. On others, a supply valve regulates oil flow to the burner supply header.

There is a definite pressure range through which oil burners operate satisfactorily. At light load you may have to cut burners out. In some installations various size tips are used, each at a different load level. This is only practical if load remains at a particular level for some time. Tips must be carefully sized to get the same oil delivery from each burner. If different-sized tips are used, it is hard to get uniform oil-air distribution. A spare set of tips permits cleaning and inspection, yet avoids unduly long outages.

When removing from service, blow out oil lines and withdraw burner from the furnace. This avoids overheating and prevents carbon formation in the tip. If burner is to be out for some time, withdraw it completely, after first blowing out supply lines with air or steam. Set it tip down in a pan of light oil to soften carbon deposits. Clean and reassemble after it cools. Usually you will have to clean burner tips regularly, although frequency varies with oil type and temperature.

Use oil torches or spark igniters each time you light off a burner. Maintain oil pressure on supply header as new burner is cut in. After putting a burner in service, check to be sure others are still lit. Use a small amount of air for lighting off; then gradually open oil and air shutoff valves, keeping them roughly in step.

Adjustment for best combustion may be critical since burner tip and air louver positions and oil and air pressures may be varied. Inspect frequently to see that you have a good flame shape, and that flames does not impinge on furnace walls or carry up into the boiler.

Tips may get dirty or start to leak. Poor atomization or formation of a pool of oil on furnace floor or in burner windbox may result. Flame should be wide and short so air is forced around and through the oil cone to obtain good mixing. Flame should be a short distance out from the burner, but not so far out as to be unstable.

The total air used will also affect burner performance. If furnace is dark and smoky, you have a deficiency of air. If there are many sparklers in the furnace and a bluish smoke issues from the stack, you have a large excess of air. Good combustion with fuel oil is usually accompanied by a light-brownish stack haze.

To check combustion efficiency, make an orsat analysis of flue gas drawn from the first pass of the boiler. This shows if there is unburned fuel or a considerable excess of air. Usual excess-air percentage with well-adjusted burners and tight setting is 10 to 15%. Set steam flow-air flow meters and combustion controls with the help of orsat analyses.

Fuel-oil impurities may cause deposits or corrosion in high-temperature zones of the boiler and superheater. Vanadium pentoxide is the most frequent and troublesome of these elements. Soot blowers help remove deposits, but sometimes you must shut down boiler and soak with water to loosen them.

Soot and ash deposits also interfere with heat transfer and gas flow through the air preheater. Blowing with air or steam may remove the deposits; some plants also use water washing with the preheater in service.

SOLID-FUEL SYSTEMS

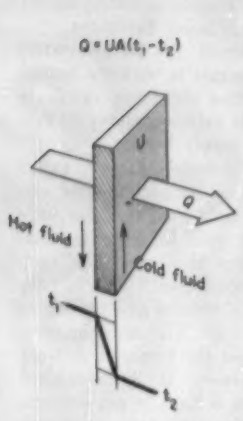
Coal-burning steam power plants carry a greater reserve fuel supply than do oil-burning plants. But for economical operation try to have coal receipts match usage. Then you can avoid in-and-out-of-storage movements. Coal may be unloaded directly into plant bunkers without extra handling, thus escaping in winter some of the troubles caused by wet, snowy coal taken from storage piles.

Bunker capacity determines filling frequency and the coal-handling crew schedule. Fill bunkers often enough to maintain several hours' fuel reserve after the usual time for starting coal unloading; this allows for accidents and delays. Keep enough coal in the bunkers to avoid need for cleaning bunkers or poking coal. Refill bunkers just before the coal-handling crew finishes work so as to have maximum amount possible on hand. If coal has a tendency to heat, clean down the bunkers at intervals. It is a good precaution to do this before the boiler goes out for overhaul.

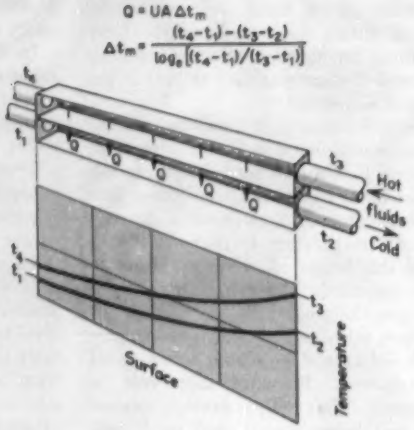
Have one operator check bunkers at start of each shift to determine coal supply and conditions. Wet coal may hang up in bunkers or coal pipes. You may have to poke the coal, hammer the pipes or use mechanical or electrical vibrators to get enough flow to the fuel preparation or burning equipment.

(*Continued on page* 200)

NUCLEAR-ENERGY STUDY COURSE: NUMBER 12



1 Heat transfer from hot to cold fluid depends on material, area, temp drop



2 Heat transfer in exchanger must be figured on the mean temp difference

Boiler designers and operators quickly feel at home with a nuclear reactor when they recognize some familiar problems: High temperatures, pressures, heat transfer, circulation—all are factors concerned with . . .

Getting heat out of an atomic reactor

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► NUCLEAR PROCESSES in an atomic reactor produce the heat needed to run a power plant. For a steam-turbine plant we must find the best way to get that heat out to generate steam. In Part 9 (POWER, April 1955) we learned that coolants carry heat out of the reactor —so we must learn something of the heat transfer between reactor fuel, coolant and steam.

Two basic cases are involved: (1) Coolant does not change state in the reactor. (2) Coolant enters the reactor as a liquid and leaves as a vapor. In the first case, the coolant enters and leaves as a liquid, or it may enter and leave as a gas, being heated as it flows through the reactor. In the second, we have the familiar case of water boiling off to steam as it picks up heat in the reactor.

Heat transfer. Fig. 1 gives the basic relations between factors involved in the transfer of heat between two fluids separated by a wall:

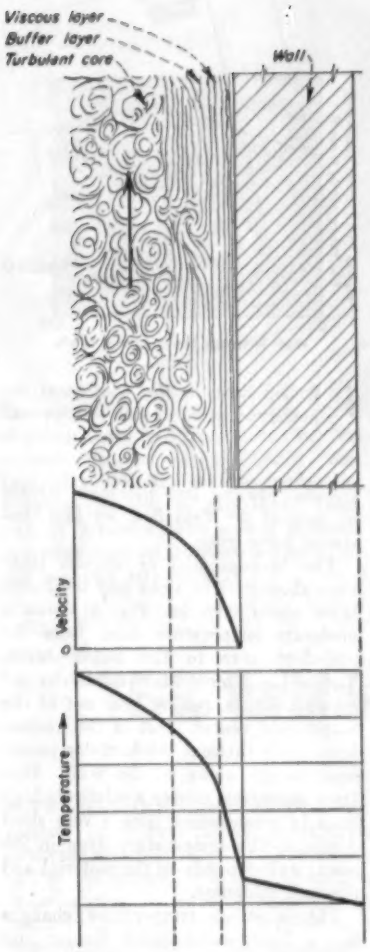
$$Q = UA\ (t_1 - t_2) \qquad (1)$$

where

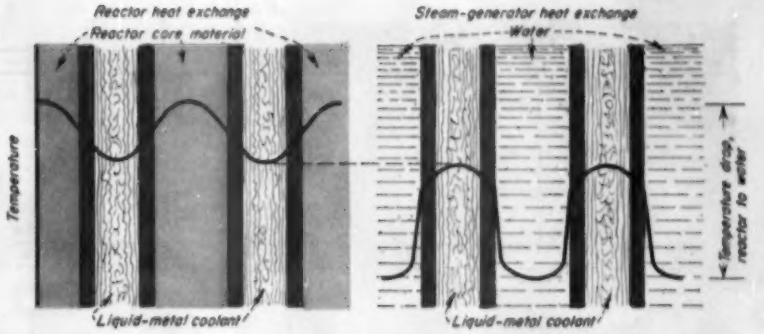
Q = heat transferred, Btu per hr
U = heat-transfer coefficient of all materials separating two fluids, Btu per hr per sq ft per F
A = area of surface through which heat is transferred, sq ft
t_1 = temperature of hotter fluid, F
t_2 = temperature of colder fluid, F

U depends on the nature of the materials carrying the heat from one fluid to another. It is high for metals, intermediate for nonmetallic liquids, low for gases and vapors. Heat transfer must pass through (1) a film of fluid on separating wall (2) separating wall (3) a film of fluid on the other side of the wall. The wall may consist of two or more solid layers. Each element has its own U, often referred to as conductance h. To find the over-all U for a series of elements making up a separating wall (fluid films and metal wall proper) we must know the h for each element and combine them by:

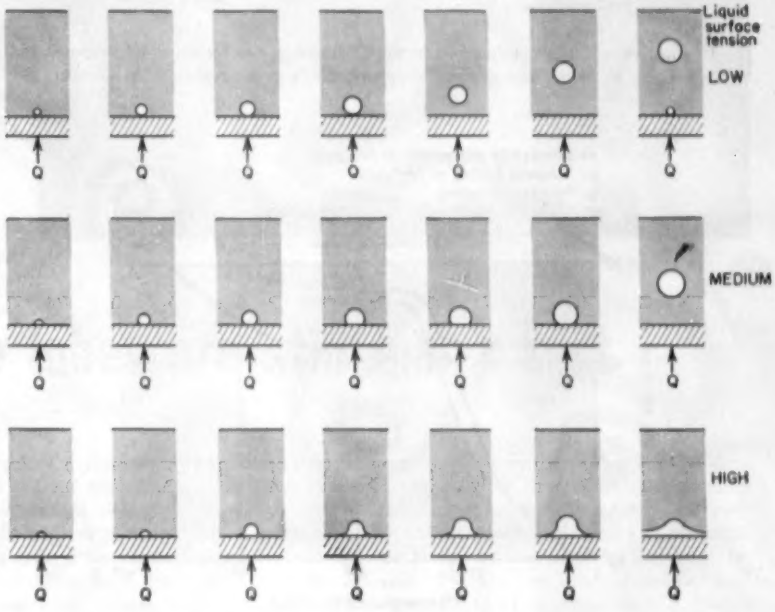
$$\frac{1}{U} = \frac{1}{h_1} + \frac{1}{h_2} + \frac{1}{h_3} + \ldots + \frac{1}{h_n} \qquad (2)$$



3 Stagnant fluid film on wall causes most of total temperature difference



4 Liquid-metal coolant has about the same heat-transfer coefficient as tube wall causing small temp drop; most of temp difference takes place in steam boiler



5 Steam-bubble formation and size depend on surface tension of the liquid, among other factors. As surface tension increases bubbles stick tighter to surface

This equation applies to a flat wall. When heat transfers through a tube wall the equation becomes more complicated—any standard text on heat transfer will show how it is derived.

Fig. 1 applies to just a small area in a heat exchanger where the fluid temperatures stay constant. In a simple heat exchanger, as shown in Fig. 2, the fluids steadily change temperature as they flow through. The hotter fluid grows colder as it gives up heat, and the colder gets warmer as it absorbs heat Q coming through the wall. To find the total Q transferred we use:

$$Q = UA\Delta t_m$$

where Δt_m is the mean or average temperature difference between the two fluids. As the temperature curves show, the differences between them vary—but Δt_m can be figured as the logarithmic mean temperature difference:

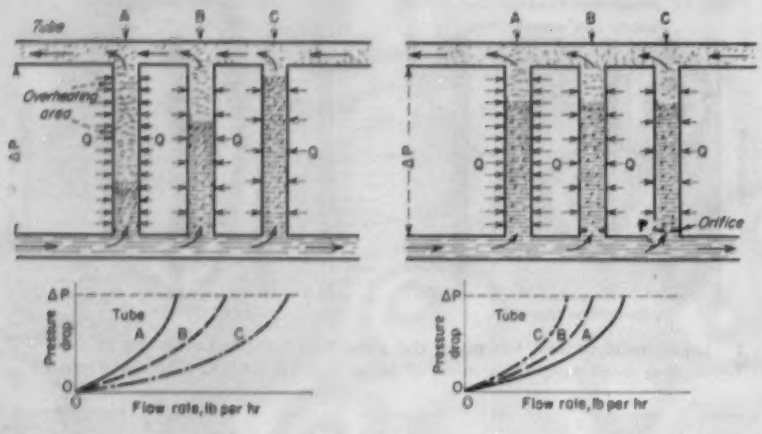
$$\Delta t_m = \frac{(t_4-t_1)-(t_3-t_2)}{\log_e \frac{(t_4-t_1)}{(t_3-t_1)}}$$

True values of Δt_m depend on the arrangement of the heat-exchange surface and correction factors must be applied. Several conditions control heat transfer within a reactor and exchanger—let's take a closer look at these without becoming too involved.

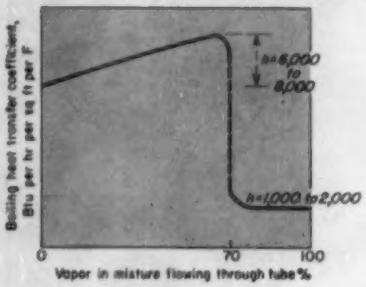
Liquids or gases. The simple job of getting heat out of a liquid or gas flowing through an exchanger to the nearest heat-transfer surface depends on:

1. Thermal conductivity of fluid
2. Thermal diffusivity of fluid
3. Momentum diffusivity of fluid
4. Fluid flow path
5. Fluid velocity

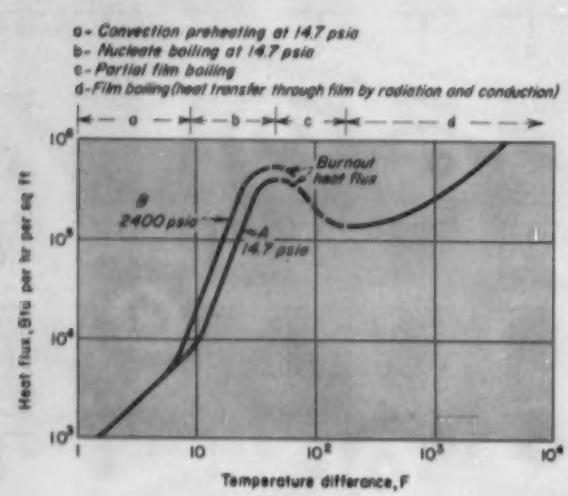
These factors are used by designers of heat exchangers when tackling an entirely new arrangement. Thermal conductivity refers to transfer of heat energy by progressive colliding of the fast molecules with slower molecules in the liquid or gas, assuming the fluid flows in a smooth manner without turbulence. Thermal diffusivity describes the natural mixing of the molecules to help this transfer of molecular en-



6 Circulation in parallel tubes of reactor or steam generator must be proportioned according to heat input to avoid flow unbalance and possible tube burnout, *left*


Boiling heat transfer coefficient, Btu per hr per sq ft per F
h=6,000 to 8,000
h=1,000 to 2,000
Vapor in mixture flowing through tube %

7 Boiling heat-transfer coefficient depends on vapor proportion in mix


a- Convection preheating at 14.7 psia
b- Nucleate boiling at 14.7 psia
c- Partial film boiling
d- Film boiling (heat transfer through film by radiation and conduction)
Burnout heat flux
B 2400 psia
A 14.7 psia
Heat flux, Btu per hr per sq ft
Temperature difference, F

8 Heat transferred depends on temperature difference and whether the boiling takes place by nucleate or film process

ergy — that is, by non-turbulent flow.

Momentum diffusivity measures the mechanical mixing of molecules by turbulence; it depends on the viscosity of the fluid and its density. Fluid-flow path depends on arrangement of the exchanger elements; the designer strives to choose the most economical one. Fluid velocity chosen depends on balancing the cost of the flow path against the heat-transfer rate achieved and the pumping power needed.

Temperature gradient. Fluids can flow at low speed through a tube so heat transfer through them depends entirely on thermal conductivity. This is called laminar flow. By raising the speed we can get turbulent flow, which helps considerably in getting heat transferred across the fluid to the surface wall. Turbulent flow is the rule in practical heat exchange.

Even with turbulent flow we run into considerable temperature drops because we can't get turbulence spread uniformly across the fluid to the wall. Fig. 3 shows an enlarged section through a turbulent stream of fluid at a confining wall. Right next to the wall there is a *viscous layer* of fluid moving in laminar flow. Right at the wall surface the fluid stays fixed at zero velocity. But as we move away from the wall we find the fluid moves smoothly at increasing speed—much like very thin films sliding over each other.

We then enter the *buffer layer* where the fluid still flows partly in laminar fashion, but whirls of turbulent fluid intrude into this zone at frequent intervals. Moving into the main stream or core of the fluid flow we find consistent turbulence.

The laminar film or viscous layer runs about 0.01 in. thick and the buffer layer about 0.06 in. Fig. 3 shows a moderate temperature drop from the turbulent core to the buffer layer. Thermal and momentum diffusivity aid conductivity in getting heat out of the hotter-fluid center. But in the viscous layer, only thermal conductivity passes heat energy along to the wall. This layer sometimes causes a relatively high drop in temperature, over a very short distance. The temperature drop in the metal wall depends on the material and the wall thickness.

Fig. 4 shows temperature changes in a liquid-metal-cooled reactor and its steam generator. Temperature drop in liquid-metal films depends on the fluid (Na and NaK) and the velocity. In the steam generator the water and steam films on the tube surfaces cause some temperature drop.

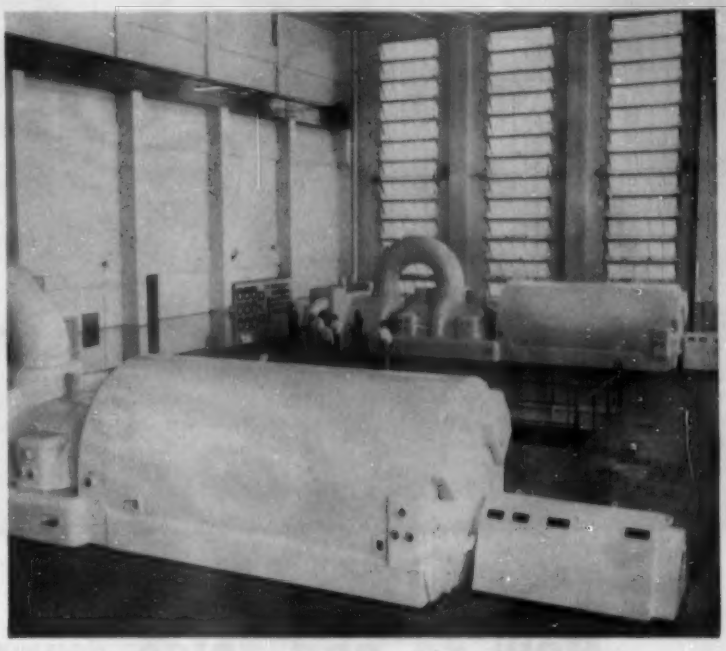
Boiling-heat transfer. In the boiling reactor we have conditions similar to those in conventional fuel-fired boilers. Boiling of water at the heated surface takes place two different ways (1) nucleate (2) film. In nucleate boiling the liquid starts evaporating at small projections of the heat-transfer surface. This forms small bubbles of vapor, which detach themselves from the surface when they become big enough and float to top of liquid.

In film boiling, a blanket of vapor forms at the heat-transfer surface. All the heat must pass through the low-conductivity vapor to enter the liquid.

In general, boiling depends on the following conditions:

1. Area rate of heat transfer or heat

(*Continued on page* 186)



Fire-resistant turbine lubes are making slow progress since above report (Power, March 1955). Effect of synthetics on generator insulation is still a problem. Trial run in a boiler feed pump turbine is under way at Duquesne Light Co. All we can say now is . . .

F-R turbine lubes are still under test

► FIRE-RESISTANT TURBINE LUBES have reached a temporary plateau since their lively spurt ahead early this year, (POWER, March 1955, p 75). Although enthusiasm for adoption of the synthetics is still present, the technical problem of using them in existing turbine-generators, without risking damage to generator insulation, is holding back the first full-scale test in an operating generator. When a practical means is on hand for protecting present-day insulation, or if a new fire-resistant fluid is evolved, we will see synthetic lubricants being used in turbine-generators now operating with petroleum oil.

Second trial run of the synthetic lubes in a boiler feed pump is now under way at the Phillips Station of the Duquesne Light Co under the direction of Dr S F Whirl. The test run has been operating successfully since late May. Fluid being used in this test is a phosphate ester material; *Monsanto Chemical Co's OS-58-1.*

In preparing the turbine lube system at the Phillips Station for its first batch of synthetic, the petroleum oil was drained and system filled with *OS-58-1.* After running for about 24 hours, this first batch was drained and a final charge of the phosphate ester fluid inserted; still *OS-58-1.* System holds about 90 gallons. A cellulose-type filter is continually in the circuit; centrifuge is used when needed. One spell of foaming was quieted with a defoamer.

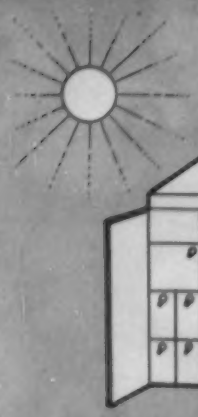
First installation of the synthetics at the Waterside Station of Consolidated Edison Co in New York City is still operating. Here, *Socony Mobil XRL-265A,* a phosphate ester-type synthetic lubricant, is successfully lubricating a Byron Jackson boiler feed pump rated 470,000 lb per hr at 4600 rpm. In this case a cellulose 2-micron filter was recently installed; a centrifuge has been on hand for entire test.

Generator insulation problem is now being carefully studied by the major generator makers. Feeling in some quarters is that a fluid-resistant coating might be sprayed directly on existing generator windings during a major overhaul. In theory, such a coating would present an impervious finish to winding insulation against harmful action of the phosphate ester fluids. Thinking in other quarters, however, questions the practicality of applying such a coating successfully.

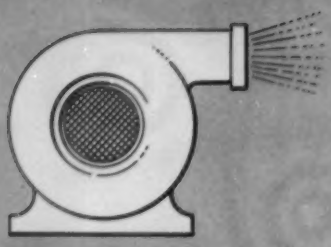
The Allis-Chalmers Mfg Co new *Silco-Flex* silicone rubber insulation (POWER, June 1955, pp 84-85), promises to bear up well under the synthetics. Tests conducted by Allis-Chalmers on *Silco-Flex* exposed to the phosphate ester fluids are far from complete, but data so far compiled indicate machines equipped with this all-silicone rubber insulation will pose no problem if the synthetic lubes are used. So, machines yet to be built can be made to withstand the new synthetic fluids, should any leak past the seals during machine operation.

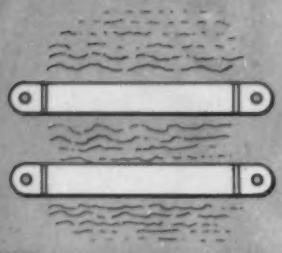
This insulation question is all predicated on the supposition that the fluid will get to the windings. In a perfectly sealed, well-balanced turbine generator, there should be no seepage of the lubricant onto the windings. But operating men, with many years of generator maintenance know-how under their belt, feel provision must be made to protect the windings since oil seepage is far from a rarity.

Foaming of the phosphate ester fluids in test service has presented a problem. Use of defoamer has proven of some help. Another approach that has been effective is extra precaution in keeping the fluid clean in service. That may be hard to do in the boiler room of a power house with fly-ash and dirt present, but operating tests indicate the installation of a suitable inert filter is most effective. Apparently presence of dirt in the fluid encourages foam.



6 ways to end unnecessary tripping of



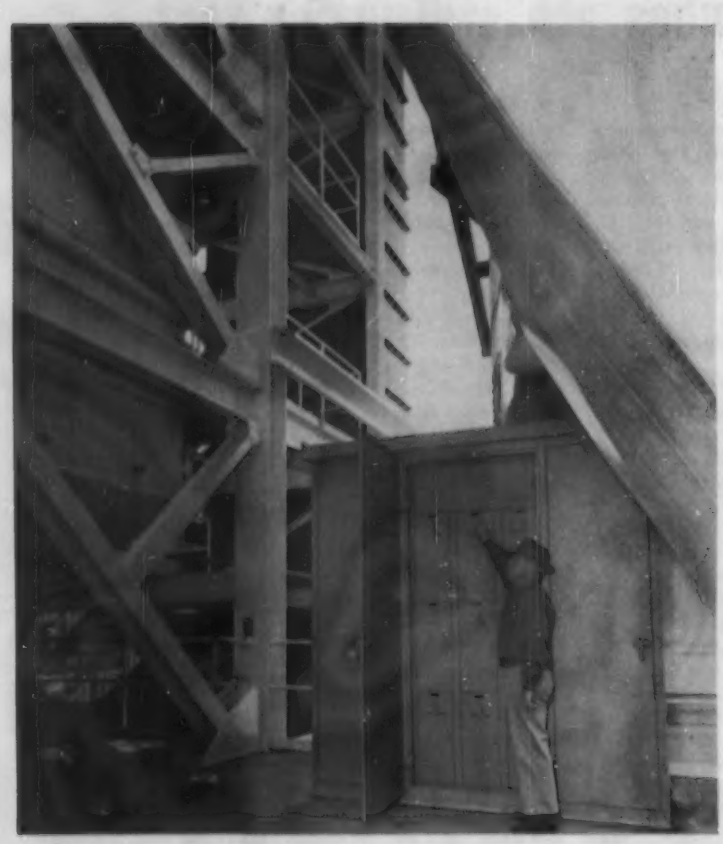


1 Insulating air space between inner and outer housing helps keep temperature down. Insulating sheets, with aluminum foil, also used. Locating motor starters in lower portion of motor control cubicle helps too

2 Forced ventilation using ducts, blowers, controls, filters, helps by holding temperature down in cubicle. If filters clog, temperature will be higher than normal. Total cost appears to be major problem here

3 Space heaters may be placed in enclosure to turn on automatically when cubicle temperature drops below intended level. Major drawback: starter insulation operates continuously at higher temperature

How to end false tripping in outdoor



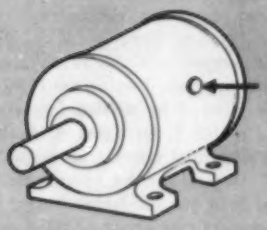
OUTDOOR CONTROL CUBICLES, located close to motor, keep feeder runs short, take control equipment out of building areas. But temperature can be problem

Motor controls are shifting outdoors to save building-dollars. But sun, high temperatures can cause needless tripping of the thermal relays.

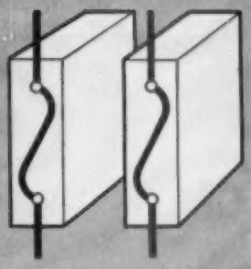
By R W BROKAW, *Industry Control Dept. General Electric Co*

► MOTOR STARTERS are generally equipped with indirectly-heated, non-temperature-compensated thermal relays fitted with replaceable heaters. They operate when a predetermined temperature is reached on a metallic strip or solder film. Some heat is contributed from the ambient, remainder from motor current flowing through the heater.

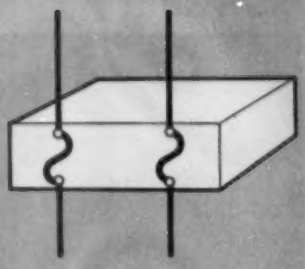
Standard heaters for thermal relays are designed for a 40 C ambient. Any temperature variation from this figure means relay trips at a different motor current; less for ambients above 40 C, more for temperatures below. This fact presents little difficulty in most indoor installations where air temperature is fairly stable. But if uncompensated relays are used in outdoor control centers, without introducing one of the six



4 Thermal device in motor is one proposed solution to nuisance tripping. Here the thermal relay in motor starter is oversized and serves simply as backup protection. Thermal device is real motor protector



5 Oversize heaters in starters prevent unnecessary tripping but as result motor is left with inadequate overload protection. Table below lists overloads permitted by the oversized thermal relay heaters



6 Temperature - compensated relays divorce ambient from ampere heat in determining relay trip point: need more space than uncompensated units. They overprotect slightly at ambients below 40 C

motor control

factors outlined above, expect variations in tripping current values.

When outdoor control centers are faced with peak ambient temperatures plus strong sun, relays may trip during normal motor operation. Consider maximum rather than average ambient temperatures when planning outdoor motor control centers. And high temperatures are not limited to any one section of the country. If averages alone are considered, the Southwest lies in hottest temperature zone. Weather Bureau temperatures are taken under controlled conditions, eliminating effect of solar radiation, so the sun's contribution must be considered separately.

To find effect of solar radiation on outdoor enclosures, a series of tests were run in Philadelphia during August 1952. Twelve sets of readings were taken under varying conditions of wind velocity and solar radiation. Recordings were made on 12 clear days. Temperature rise in upper portion of enclosure, because of solar radiation, was about 15 C. As shown on curves, p 100, a 15 C rise over a 40 C ambient causes an uncompensated relay to trip at about 85% of rating.

Six ways to approach this problem are outlined above. In brief they concern design of the control center structure; regulation of ambient temperature around relays; location, size and type of relay.

Control center structure. Manufacturers provide for an insulating air space between enclosure top and underside of outside roof. Other designs have insulating sheets with reflective aluminum foil on both sides. Such sheets are installed about 2 in. below outer roof's underside. Both the air space and insulating sheets cut down heat transfer through the roof, but not the sidewalls. Hence, a portion of solar radiation penetrates wall areas. Structural design affects rate of heat transfer, but where solar radiation is high and prolonged, ambient temperatures within enclosure will rise.

Another approach to nuisance-tripping problem is in locating thermal relays in lower portion of structure; a relatively milder temperature area. This means all starter units would be installed in lower 60% of panel while upper 40% houses feeder equipment. This arrangement will eliminate most unwanted tripping. However, too often control units in any one panel fail to contain the required ratio of starters

Rating of normal and oversize heaters for uncompensated thermal overload relays

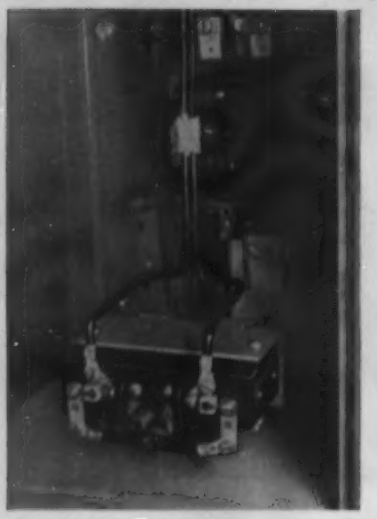
Continuous 40-C-rise induction motors; 440 v, 3 ph, 60 cyc, 1800 rpm

	Amperes	Heater rating—amperes			Heater rating—% full-load current		
Hp	Full-load current	Normal	1 size larger	2 sizes larger	Normal	1 size larger	2 sizes larger
5	6.85	8.40	9.22	10.1	122.6	134.7	147.5
10	13.2	15.7	17.8	18.5	119.0	134.9	140.1
20	25.5	31.8	35.0	38.0	124.7	137.2	149.0
30	37.1	45.5	55	61	122.7	148.1	164.3
50	60	73	80	92	121.8	133.3	153.2
75	91	113	130	150	124.2	143.0	164.9

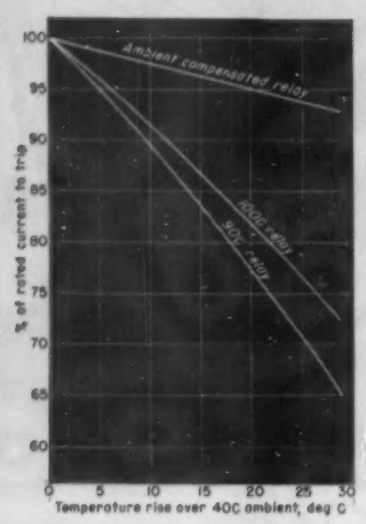
Continuous 55-C-rise induction motors; 440 v, 3 ph, 60 cyc, 1800 rpm

5	6.2	6.32	6.95	7.64	102.0	112.0	123.2
10	13.6	14.0	15.7	17.8	103.0	115.4	131.0
20	27.0	28.4	31.8	35.0	105.2	117.8	129.6
30	39.2	40.5	45.5	55	103.4	116.0	140.2
50	63.5	68	73	80	107.1	115.0	126.0
75	94	97	113	130	103.2	120.2	138.4

Compensated relays are often the best bet



AMBIENT-COMPENSATED relay in starter compartment has hand-reset overload



TRIPPING POINT of an uncompensated relay changes markedly with temperature

and other equipment to make this method practical. A control center housing mainly motor starter units would include a great deal of empty space in the upper portion.

Temperature regulation within enclosure is another possible solution. One way to do this is with space heaters in the enclosure, switched on automatically whenever temperature drops below intended level. Big disadvantage here is that motor control would be operating continuously under worst temperature conditions from the insulation angle. Remember that more heat is needed than can be supplied by space heaters furnished to cope with condensation. In addition to the cost drawback, such heaters are not practical unless all vent openings are blocked closed.

Some engineers have considered forced ventilation. If dust is a problem, an effective filtering system must be provided and maintained. The assumption is also made that space is available for blowers, ducts, filters and control. More often, the cost angle would rule out this approach.

Thermal devices in motors is another proposed solution. Here the technique may include back-up protection by thermal relays in the motor starters. Latter would be chosen for a current about 50% above normal. As indicated in table, p 99, this requires a heater one or two sizes larger than normal. As discussed below, such relays contribute little toward motor protection. Therefore the burden of protection falls on the thermal device located in the motor itself.

Oversize heaters are used by many operators to end nuisance tripping, yet, not without introducing their own set of problems. When an oversized heater is installed, a relay-heater combination exists that will operate satisfactorily and provide overload protection *under the higher ambient temperature conditions*. But these conditions occur only during a part of hot sunny days, thus representing only a small percentage of total operating time. Biggest chunk of the operating time generally is spent under lower ambient conditions where oversized heater fails to adequately protect. In some cases, where temperatures are extreme, it is necessary to use heaters two sizes larger than normal providing even less overload protection.

Standard 40 C rise motors are designed for continuous operation at 115% full-load, without exceeding insulation temperature-limits. Since no service factor is applied to 50 or 55 C rise motors, heaters for such motors are selected on basis of rated motor current. Table on p 99 lists current ratings for some typical 40 and 55 C rise induction motors. Note a 30-hp open motor, with a heater one-size larger than normal, carries about 145% full-load current indefinitely in a 40 C ambient without the relay tripping. With normal size heater, motor trips in about 15 min at 145% load. As a further comparison, with a heater two-sizes larger than normal in a 40 C ambient, motor operates indefinitely at 163% full load. Correct size heater trips relay in about 7 min.

What does this mean temperature-wise? Under steady-state conditions, motor temperature-rise varies about as current squared. Letting the 115% load figure allowed by service factor correspond to 105 C for *Class A* insulation, the 145% load current corresponds to 126% load. Thus, an open motor protected by a one-size-larger heater has a temperature rise about $(1.26)^2$ or 1.58 times normal. *Class A* insulation carries a 105 C hot-spot temperature limit or a total temperature rise of 65 C over a 40 C ambient. Heaters one-size larger, operating to their limit in a 40 C ambient, may produce a temperature rise of 1.58 times 65 C or about 103 C giving a total operating temperature of 143 C. Going a step further, a heater two sizes larger would operate continuously with motor at about 173 C hot spot without the relay tripping.

With 50 or 55 C rise motors, no service factor is included. So taking the 30-hp motor again, without service factor, a heater one-size larger could mean a hot-spot temperature of about 127 C while a heater two-sizes larger could raise this temperature to about 167 C.

These examples point up the serious drawback in merely increasing heater size as a means of preventing nuisance tripping. In brief, the method falls far short of being a practical means for licking the problem.

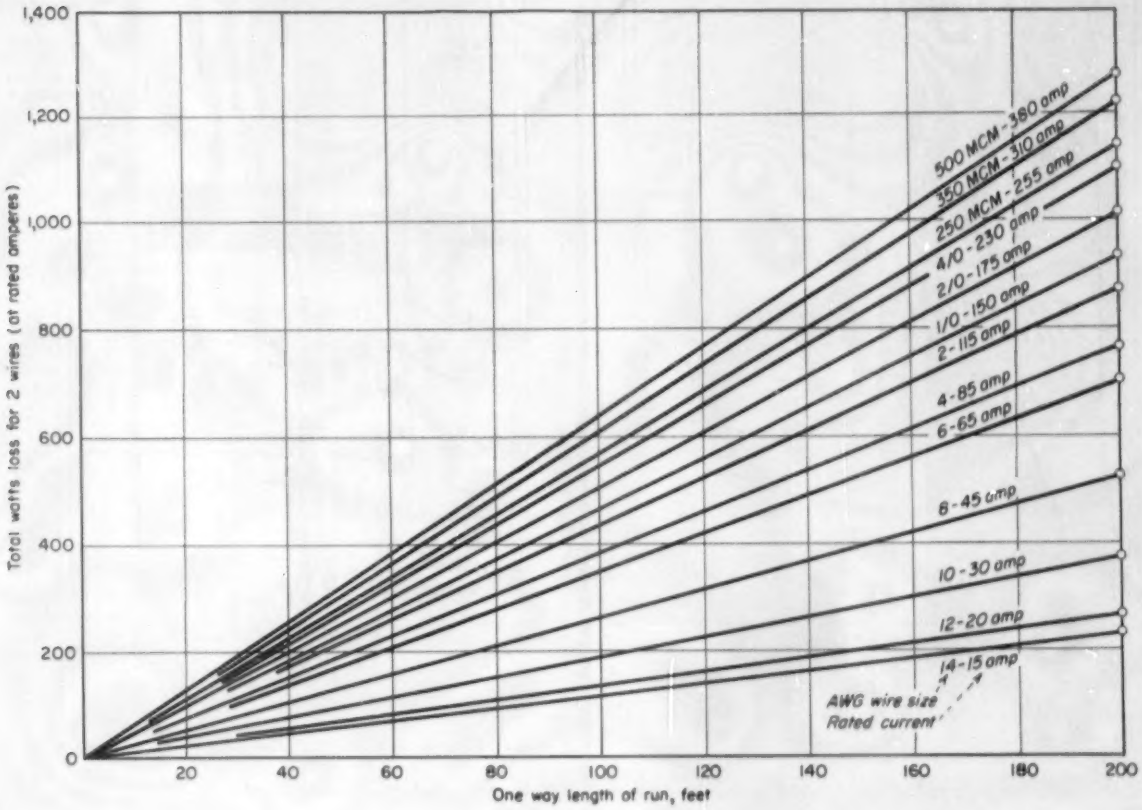
Compensated thermal relays that in effect recognize the heat source, may prove a sound approach. So if a fixed quantity of heat from the overload heater trips the relay, an equal amount from the ambient air will have little effect on tripping point.

Curves, above, illustrate that each 10 C rise in ambient above 40 C for an uncompensated relay can decrease trip current value more than 10%. But an ambient temperature - compensated relay may vary only 2 or 3% for each 10% change in ambient. Using ambient-compensated thermal relays for low-voltage motor starters is not new. The Navy and maritime ships have been using this type protection for years. Benefits are obvious here since a ship may be operating in the tropics one month and the arctic zone next, often with motor and control in separate locations. Why haven't they been more widely adopted for general industrial use? Two reasons: (1) motor controls have but recently seen widespread application outdoors when the benefits of compensated relays are most pronounced (2) space limitations in standard motor control centers often pose a

(*Continued on page* 200)

Power's DATA SHEET

No. 278



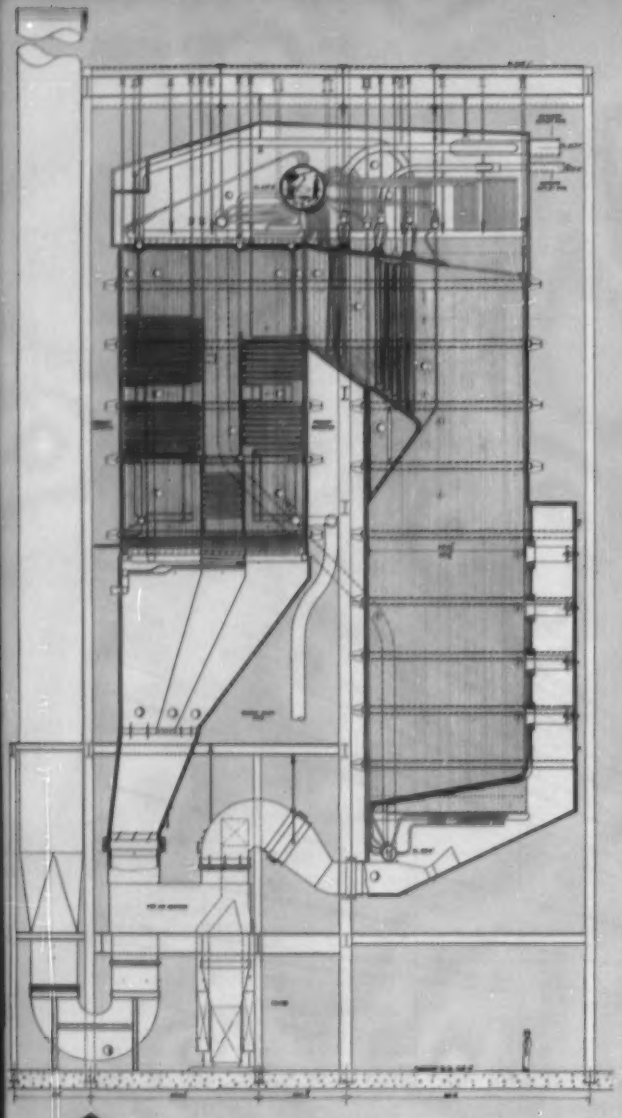
Watt loss in electrical conductors

This chart gives the watts lost in insulated conductors from No. 14 to 500 Mcm sizes when carrying their allowable capacities. These figures cover 2-wire circuits for length of runs up to 200 ft. Not more than three conductors should be placed in the raceway or cable or together in direct burial. These figures are based on room temperature of 30 C (86 F) on data given in *1953 National Electrical Code*, Tables 1 and 18.

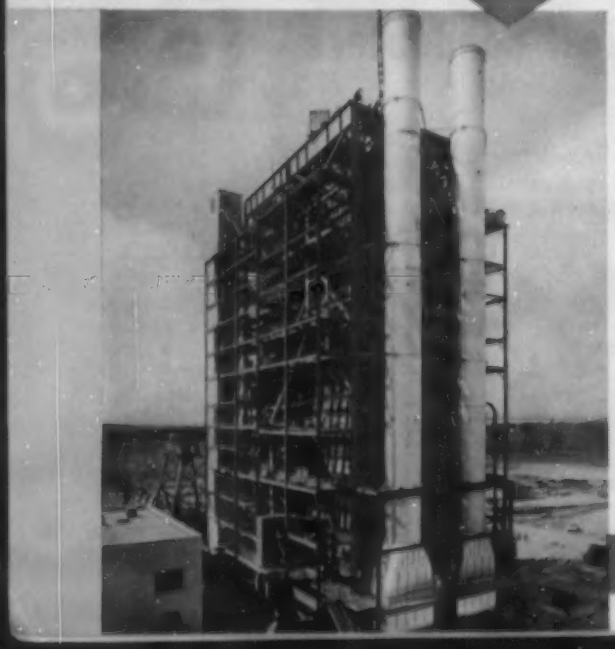
NORTON SAVAGE, *Oak Park, Michigan*

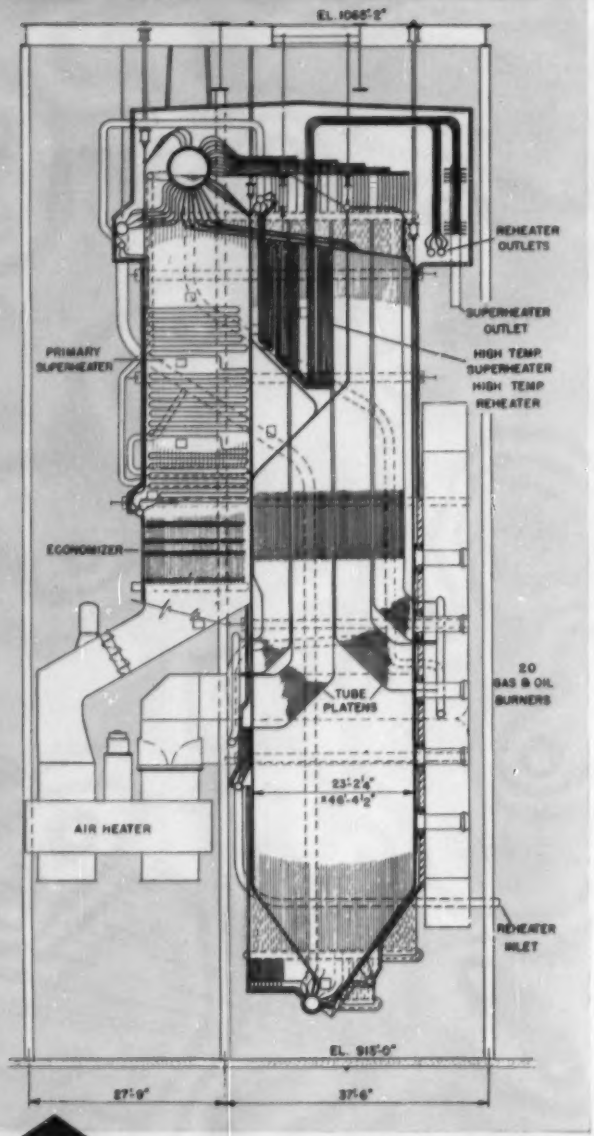
POWER pays $35 for each accepted Data Sheet. Why not submit yours today?

© POWER



Louisiana Power & Light Co., Nine Mile Point Station — Ebasco Services, Consulting Engineers — 1-1,000,000 lbs/hr reheat unit with pressurized furnace — 1725 psig; 1005F/1005F Reheat.





City of Los Angeles — Department of Water & Power — Valley Steam Station 2-1,200,000 lbs/hr reheat units - 2075 psig; 1000F/1000F Reheat.

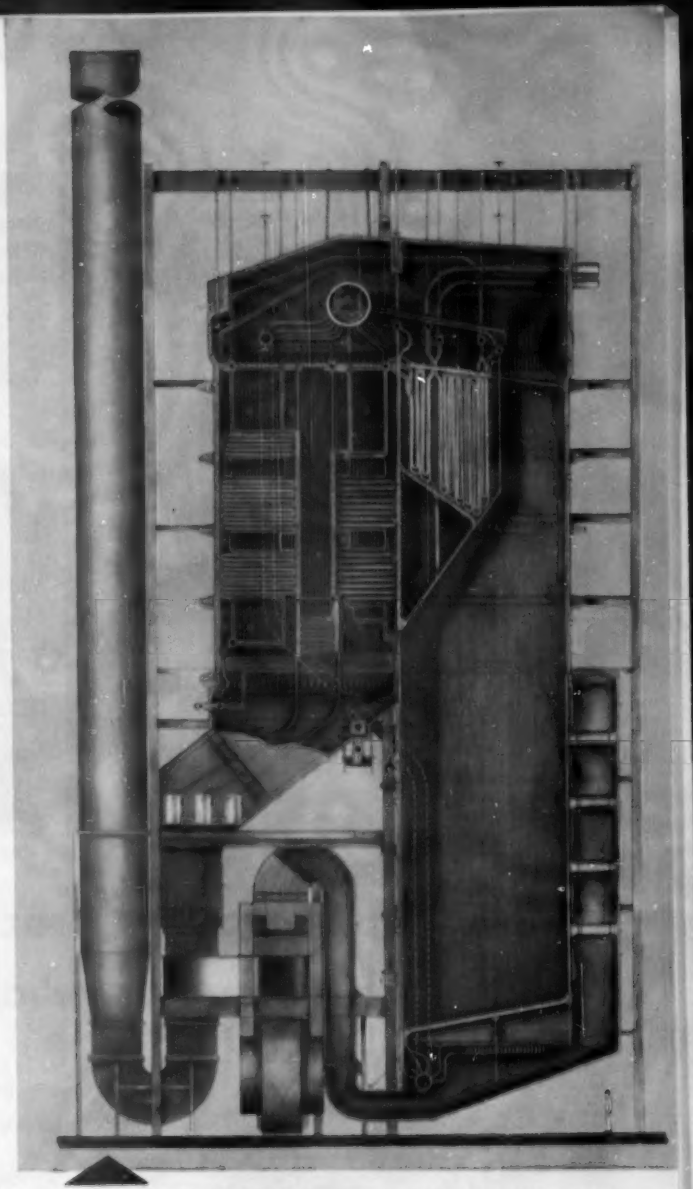
The acceptance of Riley for big reheat and pressurized units by the public utilities . . . the marked swing to Riley has been brought about by outstanding design characteristics such as those found in these three Riley units . . . low furnace exit temperatures through the use of radiant surface preventing objectionable slag formation; wide load range with stable ignition with damper or a combination of damper and spray control; high yearly net efficiency, dependability, and continuity of operation.

A survey of your power plant by your consulting engineer will possibly show ways of making surprising savings in your power costs. There is a Riley representative in all principal cities.

RILEY STOKER CORPORATION • Worcester, Mass.

COMPLETE STEAM GENERATING UNITS AND

for the BIG JOBS more and more public utilities rely on RILEY



Houston Lighting & Power — Deepwater Station and Sam Bertron Steam Electric Station — Ebasco Services, Consulting Engineers — two 1,250,000 lbs/hr reheat units with pressurized furnaces — 2125 psig - 1005F/1005F Reheat.

All of these public utilities have purchased Riley Steam Generating Equipment.

†Dallas Power & Light Co.
†*Texas Electric Service Co.
†*Houston Lighting & Power Co.
*City of Los Angeles, Dept. of Water and Power
†*Louisiana Power & Light Co.
Monogahela Power Company
Potomac Edison Co.
West Penn Power Co.

Arkansas Power & Light Co.
*Utah Power & Light Co.
†*Florida Power Corporation
Florida Power & Light Co.
*Central Illinois Light Co.
†Southern Nevada Power Co.
†*Central Louisiana Electric Co.
Northern States Power Co.
Philadelphia Electric Co.

Commonwealth Edison Co.
Northern Virginia Power Co.
Gulf Power Co.
Pennsylvania Electric Co.
Interstate Power Co.
Ohio Edison Co.
Montana-Dakota Utilities Co.
Mississippi Power Co.
Otter Tail Power Co.

†New Orleans Public Service Co.
†Southwestern Gas & Electric Co.
*Public Service Co. of Indiana, Inc.
Columbus & Southern Ohio Electric Co.
South Carolina Electric & Gas Co.
Southwestern Public Service Co.
Union Electric Co. of Illinois
*Dairyland Power Cooperative
Iowa-Illinois Gas & Electric Co.

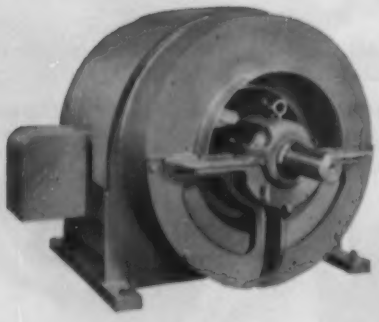
*Reheat †Pressurized

FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS

All of the bars of this squirrel-cage rotor are being joined simultaneously to one end ring by the Westinghouse high-frequency brazing process. The end ring is heated by high-frequency currents induced by the coil on which it rests, and conduction carries heat to the bars. This process inspects itself . . . the red-hot bars are clear proof of positive joints.

A big extra in large motors . . .

Westinghouse special brazing process boosts rotor reliability, slashes maintenance



This is a large standard type CSF drip-proof motor. It can easily be modified to meet any special mechanical-drive requirement.

High-frequency brazing eliminates rotor joint failure . . . proved on over 1500 motors operating up to five years without a single failure

This technique licks the biggest single trouble spot in rotors of large motors. Bars are brazed to the end rings—and connections are tested at the same time. It is the only way to get solid, indestructible joints . . . your positive assurance of reliable operation under the toughest conditions.

You get many important extras in Westinghouse large motors. Thermalastic® insulation, for example, gives over 20% increase in dielectric strength, 10-to-1 increase in voltage endurance—withstands moisture, dust and corrosive atmospheres.

Both of these features have been extensively proved in service. They give you a motor far superior in performance and long life . . . the closest you can come to a completely maintenance-free mechanical drive. For full range of sizes and application assistance, call your local Westinghouse sales engineer, or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10444

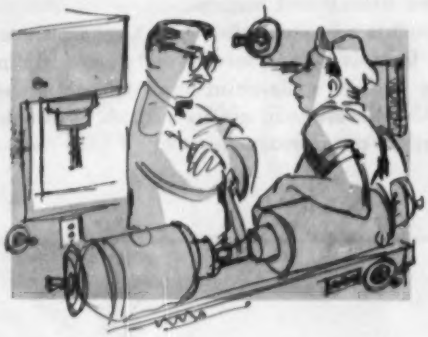
YOU CAN BE SURE . . . IF IT'S

Westinghouse

STEVE ELONKA
Associate Editor in Charge

1 Consultant meets management...

2 Talks to chief operating engineer...



3 Looks for ideas in the plant...

4 Presents his plans for cost cutting

4 *steps to cut plant operating costs*

Here, straight from the files of a trouble-shooting consulting engineer, are the facts on how you can use the services of this type of specialist to save $$ year round in your plant. And if you want, you can apply his methods on your own to step up plant efficiency

By **SALVATORE S GUZZARDI**, *Consulting Engineer*

Turn page

1 Consultant meets management . . .

Trouble-shooting consulting engineers can bring a new outlook to management and operators. Since most of management's problems are with production, advertising and sales, the power plant is usually overlooked as a potential source of profits.

I've often translated power savings into terms of sales, telling management that certain changes would produce the equivalent of so many millions of dollars of sales. Their ears perk up fast because they know their net on sales runs a certain percentage of the total—say 5 or 10%. The power plant becomes of real importance when management realizes that it, like sales, can produce profits. Then, and only then, are management and engineers talking the same lingo.

Pick consultant. Like many other specialists, the consultant who makes trouble-shooting his main job is often a blend of several personalities. He must be observant and skilled in analyzing many plant operations. If possible, he should have a knack of stating his findings in terms management easily understands. For if he cannot get his ideas across to non-technical men, he'll have a tough job convincing them it is worth spending money for plant improvements.

Have a survey made by the consultant to find if any savings are possible. These surveys seldom take more than a few weeks. Then the consultant can give management a clear picture of what he thinks can be done to make savings. His fee for this work is usually decided between himself and management.

Though a consultant often goes first to plant management, there is no reason why the plant operating staff cannot seek out a consultant or recommend a particular one. Also, the staff can use his methods in trouble-shooting various plant operations.

---

3 Looks for ideas in the plant...

In large plants with hundreds of employees, the chief operating engineer is often too busy to get to see every man in the plant. Yet machine operators and production-line employees often have sound ideas on how a plant can be improved. Sometimes they do not have the initiative or ability to put ideas across to management. Tapping this source of ideas can prove most helpful.

Steam load for presses in a clothing manufacturing plant was extremely high. Talks with press operators showed that in summer the press-room heat was almost unbearable. Looking at the presses, I found they were uninsulated. Steam consumption at night ran 70% of the day load. Insulating the presses cut the steam consumption considerably, increased production rate.

Another plant, spending $400,000 per year for fuel did not have a single thermostat, though most of this fuel is used for generating steam for building heat. Personnel were extremely uncomfortable because there was no regulation of steam supply other than shutting down one or more boilers. Steam was kept on at night and over the weekend. Use of suitable thermostats could easily cure this problem.

Management would be wise to allow the operating engineer to assign one or more men to getting ideas from all employees in the plant. This crew would review plant costs, production rates and other operations at regular intervals to learn how improvements to cut costs could be made. Study of fuel costs, electrical demand and steam needs might bring up some old ideas, but it is almost certain to uncover gems worth much in plant savings.

This trouble-shooting crew should be free to roam the plant, ask questions, make suggestions and review reasons for doing a task in a certain way. You can't come up with savings without digging for the facts.

2 Talks to chief operating engineer . . .

A consultant needs all the help operating engineers can offer in the way of records, production data, etc. He also needs facts on current problems, operating methods and personnel. I'd say that half the success of any survey like this depends on the plant staff. We provide solutions to their problems, but need their help from start to finish. Their unstinting cooperation is one of our best tools.

Over-designing, a fault I often see, is easily pointed out by the chief operator. In a hospital where a new wing was being added, increasing the heating load about 20%, an entire new power plant was recommended by the architect. But the operating engineer pointed out to me during a survey that one existing boiler in the plant could easily handle the increased load. We also found that by adding temperature control to the building we would reduce steam needs 20%. This could be used to heat the new wing without any increase in fuel consumption. Cost of temperature controls was less than 1% of a new plant.

In a shipyard I found a 24-hour watch being kept on two large propane storage tanks to see that gas temperature stayed between 50 and 100 F. Watchmen controlled steam or water flow to the tank to raise or lower gas temperature. Total expense of four watchmen for this job ran about $20,000 per year. Automatic valves, costing a total of $100, were installed to regulate steam and water flow. For an investment of this small sum, the yard now saves $20,000 a year in labor costs. That's supersonic write-off.

Operating engineers can use the same scheme in tackling their own problems. The secret is simple—try to see a problem from an outsider's viewpoint; forget all the minor side issues. Sometimes we overlook the obvious in our haste for answers.

---

4 Presents his plans for cost cutting

This is where the consultant proves his worth. He shows management how much it can save by minor or major alterations of the plant equipment.

In a museum recently, I found half the building heated by a coal-fired boiler, the other half by an oil-fired unit. Both boilers were interconnected and the automatic oil-fired unit had enough capacity to carry the entire load. Opening two valves in the system eliminated the coal-fired boiler and allowed reassigning four firemen used for it during the heating season.

Of course, not every problem is solved this easily. Management may have to spend for new units, controls or other improvements. But my experience shows that there are many plants where such expenditures can be easily justified by the savings made.

Once management knows what kind of a return they can get on their money, it is usually easy to convince them that the investment should be made. In one plant, a $60,000 investment gave $90,000 annual savings. So in the first year, management more than recovered its capital and every year thereafter grossed an extra $90,000. At a net profit of 3% this is equavalent to an additional $3 million in sales. Show me the firm that would sneeze at a figure like that!

Changing a plant from coal to oil firing allowed us to reduce the manpower needs from 22 to 9. The resulting labor-cost savings were enormous.

While the new outlook a consultant brings with him is a major item in making savings, many operating men can do as much by taking a new view of their plant. It is the change in perspective that helps us see other solutions to our old problems. And once we get such a program started it will roll along at a good rate because one saving leads to another.

Installation

Pour the insulation

Tamp under pipe

Now, granular insulation pours on easily. Heat fuses it to protect hot underground pipe

By JOHN F WILLIAMS, *Chief Engineer, Gilsulate Div, American Gilsonite Co*

► THE SIMPLE STEPS of pouring, tamping and backfilling pictured above are all that's required for installing this type of insulation for hot underground pipes.

Then when heat is passed through the pipes for 24 hours, the granules form three distinct concentric zones—a plastic area surrounding the pipe, a sintered zone, and an outer layer of unconsolidated particles. Each of the three provides certain helpful protections for the pipe as noted under "Results" on the facing page.

Composition. There are three types of this insulation, to take care of pipe temperatures from 220 to 520 F. The granules are made from specially sized and blended gilsonite, a high-resinous-content hydrocarbon found only in northeastern Utah. The product, known as Gilsulate, is produced by American Gilsonite Co.

This material has been tested under various conditions for the last six years. It is granular in form, and is simply poured from bags by hand, around the pipes. No special protective linings or preparation of trenches are required. Bare pipes are placed on supports in ordinary trenches, the material poured on and tamped down lightly, and the trenches backfilled. Unskilled labor can do the job. There is no need for highly trained applicators.

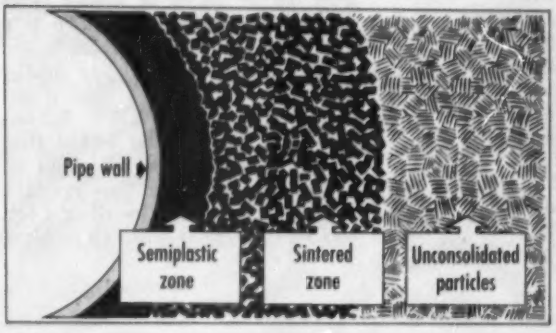
The material gives lifelong thermal insulation and protection from corrosion, and provides permanent protection from other conditions that may attack buried pipes, like acid or alkaline, ground waters, electrolysis, root attacks and bacterial action.

Avra installation. In an installation at Arizona Public Service Co's new Saguaro Steam Electric Station at Avra, 40 tons of this insulation were poured and tamped by ten laborers in two 8-hour shifts. The insulation covers three seamless carbon-steel lines with welded joints that are laid side by side in a 37-in. wide trench. The underground installation totals some 1200 ft, with five horizontal expansion U bends. Pipes run between a 55,000-barrel fuel-stor-

Cover the pipes

Tamp surface

Backfill the trench



Results

After insulation particles are tamped down, heat passing through the pipe forms three zones of protection. Material directly against the pipe wall melts, becoming fused with the wall. This forms a dense coating ½ to 1 in. thick that is plastic enough to allow normal expansion and contraction from heating and cooling. The coating is waterproof and affords thermal and electrical insulation.

A sintered zone, in which the particles are coalesced by heat, surrounds the plastic area. This sintered zone provides thermal insulation and protects against moisture penetration.

Outer layer of unconsolidated particles provides further insulation and is the load-bearing portion of the structure.

age tank and two 950,000-lb-per-hr steam generators.

There is a 6-in. fuel-oil supply line, a 4-in. fuel-oil return line and a 4-in. saturated-steam line leading to the fuel-oil tank heater. Steam pipe temperature is 350 F.

Pipes were laid three feet deep and supported to allow six inches of space around each. Pipes must be supported above the bottom of the trench so hot pipes do not alter the proper three-zone structure. The action of hot unsupported pipe would be very similar to pressing a hot soldering iron into a block of wax.

To form the protective zones around the pipes, all three were heated to the necessary temperature for 24 hours. After that, each pipe was permanently protected not only at temperatures in the specified range, but at lower temperatures too.

Insulating properties. The insulation cuts heat loss to 8 to 11% of the loss that would occur from bare pipes in the same trench. If the unconsolidated particle zone becomes thoroughly wetted, insulating efficiency of the structure is lowered 7 to 8%.

The plastic and sintered zones are watertight. When the unconsolidated zone is tamped according to the manufacturer's specifications, it requires an 18-in. static head of water to fill the interstitial air space of this zone. The insulation particles have no pores and do not absorb water, hence the plastic zone does not depend on air spaces for its insulating value.

Manufacturer's installation specifications cover all pipe sizes or combinations of sizes from diameters of 1 to 16 inches. Some of the material shrinks about 35% in volume when it passes from the unconsolidated to the solid form. This shrinkage occurs in the plastic zone surrounding the pipe. In an average 4-in. envelope the surface will be depressed about ⅜ in.. If pavement is to be laid over the insulated lines, the structure should be formed first, and then the backfill tamped to grade. No settling will occur after this.

OPERATORS' NOTEBOOK 88

You must know how

Oil must be warm

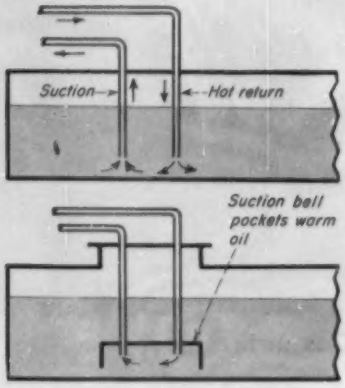
Fuel oils must be stored and pumped through piping while warm. Too little thought is usually given to this important fact, often causing trouble after system is installed. Today, plant operators have a bigger headache since heavy fuel oils are becoming heavier with higher pour points and viscosities. This means your present fuel system won't do its job, although it once might have worked.

Three points must be considered. (1) You must store oil warm enough so it can flow toward your suction line for removing it from tank. (2) Oil must be easily handled in piping system from fuel oil storage tank by fuel pump and in quantities demanded by burner. (3) Oil must be delivered to the burner in a state ready to burn. So you can see that these are three separate steps.

Pumpability. Experience has shown that 5000 ssu is the limit of easy pumpability. Also that a No. 6 oil of 100 ssf at 122 F will reach the 5000 ssu when its temperature is about 83 F. Today, No. 6 oils have a commercial range of between 100 and 200 ssf at 122 F. Often this reaches 300 ssf at 122 F. For heavier grades, storage temp must be close to 110 F instead of 83 F.

Some heavy fuel oils may have a maximum pour point as high as 90 F although standard ASTM pour test may call for a much lower pour point. This is because pour point of residual fuels is not certain; it depends on initial temperature before cooling and time held at this initial temperature. So anything less than 110 F suction temperature might give pour trouble even if chart viscosity temperature characteristics show pumpability at lower temperature. Then multiple-tank installations, tanks exposed or in wet soil and tanks buried below ground in cold climates must have some means of heating oil at suction inlet to 110 F. And heating must be at rate you withdraw oil. Return unburned hot oil to tank bell at suction. But this may not solve problem on cold starts. *Courtesy, Preferred Utilities Mfg Corp, New York, N. Y.*

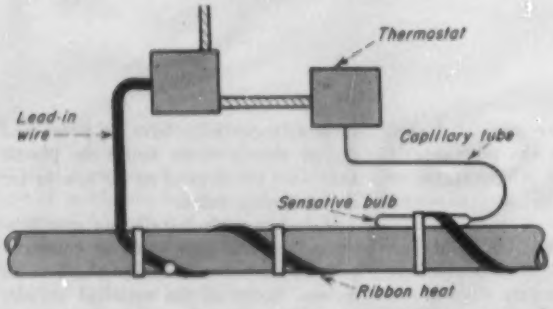
Heating in the storage

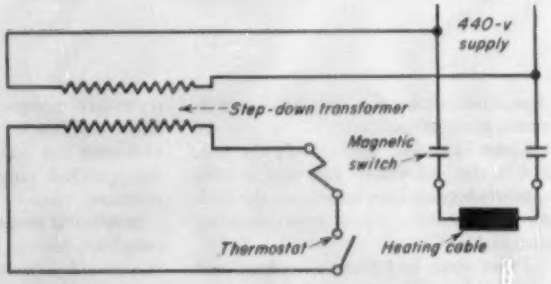


Suction bell

Most Codes require oil to be withdrawn from top of buried or vaulted tanks through suction stub reaching 6 to 8 in. from tank's bottom. Where heated oil is frequently pumped into smaller tanks, you may have no trouble if suction is near return, top sketch. But second sketch shows a better method. Here inverted bell traps the hot return oil that suction and return lines run into. This simple change of installing a bell may solve a serious pumping problem.

Ribbon heat





Now, electric line heaters keep your heavy oil hot on startup

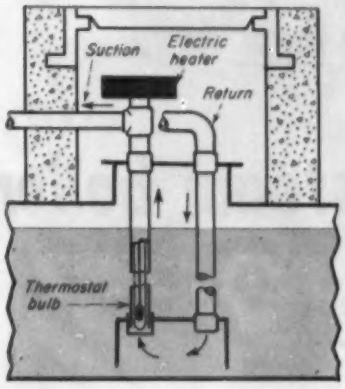
Ribbon heat is a low-temperature lineal heater in form of flexible tape ½-in. wide and 1/10-in. thick. Heat is from electricity passing through four special resistance wires. All are insulated and waterproofed.

The end of this special heating tape is attached to waterproof connection of 3-ft non-metallic sheathed cable. Entire assembly is sealed at each end, not harmed by mild acids or alkalies. Use where maximum fuel temperature flowing through line is not above 170 F. Plants have been shut down where hot-storage oil flashed in the pump. All of ribbon-heat units are single phase of 110-220 or 440 volts. And they must be installed across one phase of the polyphase supply. The 440-v units in this line have a single-pole pilot thermostat operating the coil of a two-pole relay.

to heat residual fuel oil

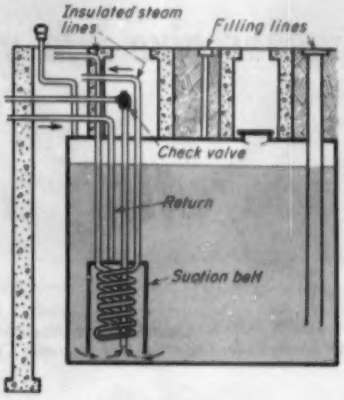
By STEVE ELONKA, *Associate Editor*

tank is important



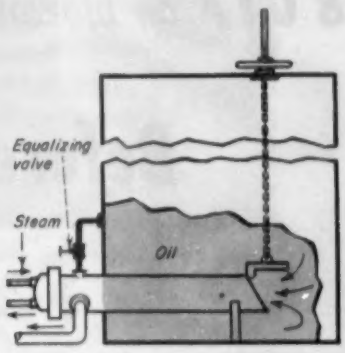
Electric heater

Suction-stub electric heater shown keeps oil at needed temperature inside suction-stub pipe section during shutdowns. This is a low-watt density, thermostatically-controlled immersion heater. Wattage available in this suction heater is low. It is not for heating oil other than to keep it pumpable during shutdowns. Thermostat is usually set for 100 to 110 F. Place a drain in concrete enclosure around manhole if water collects. This prevents flooding.



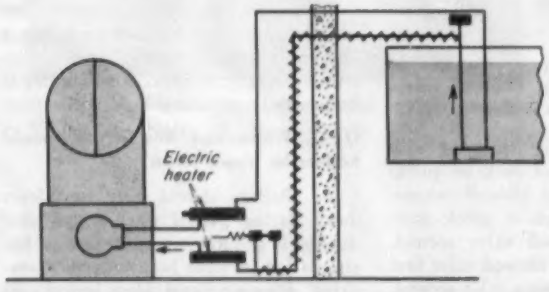
Coil and bell

Coil heater combined with suction bell is very efficient. Coil in bell heats oil as it is withdrawn by pump. Here very little heat is needed as heated oil does not mix with large quantities in the tank. Besides, hot return from burner is also to bell. Hot water may be used instead of steam in coil, depending on local ordinance and hot water available. If high-pressure steam is used, control with temperature control valve. To play safe, send exhaust to waste.



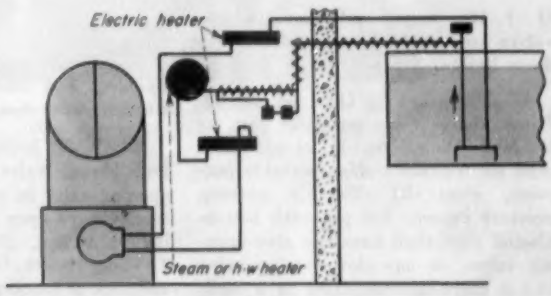
Field-storage tank heater

Large field storage tanks should have a suction- or tank-outlet heater. Open end of heater shell extends into tank. Fuel suction is on closed end, outside of shell. If you have oil return line, connect outer part of shell so hot return oil does not dissipate with stored oil. To repair coils, close large clapper valve so coils can be removed without emptying tank. Equalizing valve fills the heater with oil, helps you open clapper valve when heater is empty.



All electric heating

Electric suction-stub heater is in vertical suction line in storage tank. Ribbon heat around long suction piping keeps oil in pumpable state. Electric heaters in tank bring oil temperature to fire point needed for burning. Data for selecting proper unit or ribbon heat sizes are based on piping covered with at least 1-in. thick sponge-felted asbestos or its equivalent. Such insulation fits firmly over flat coils.



Electricity plus steam or water

Suction-type steam or hot-water heater is added here. Ribbon heat is for holding oil temperatures in insulated pipe lines during shutdown or out-of-service periods. Their purpose is to maintain the pipe line at a suitable temperature by making up for radiation and convection or conduction losses from piping. So don't expect ribbon heat alone to maintain oil temperature when flowing through fuel line.

8 Q&A on blowoff valves give info you must have...

Before operating a steam boiler

By JOHN TODD, *Chief Inspector, New York, Hartford Steam Boiler Inspection and Insurance Company*

► START TALKING ABOUT installing and operating boiler blowoff valves and piping if you want to get into a sure-fire argument. POWER readers recall many views on this subject in "Argument Corner" several years ago that were started by "Operators' Notebook 52," April 1952.

Questions and answers given here comply with Sections I and VII of ASME Code. They will clear up any doubts and possible misunderstandings you may have.

EDITOR'S NOTE: *Letter P indicates Section I, Power Boiler Section of ASME Code, while paragraphs with preface C are found in Section VII or Care of Power Boiler Section of Code.*

Q 1. How many and what kinds of valves are required on a boiler blowdown line?

A. Paragraph 311(a) of *ASME Power Boiler Code* reads, in part, as follows: "On all boilers, except those used for traction and/or portable purposes, when the allowable working pressure exceeds 100 psi, each bottom blowoff pipe shall have two slow-opening valves, or one slow-opening valve and a quick-opening valve or a cock complying with requirements of P-310."

Q 2. What is meant by a slow-opening type of valve?

A. Slow-opening type valve is one requiring at least five 360-degree turns of operating mechanism to change from full-closed to full-opening and vice versa. [P-311(a)]

Q 3. Is an ordinary type globe valve permissible for blowoff service?

A. This type valve is not permissible. Reason is that globe valve has a dam or pocket where sediment can collect and which might interfere with proper closing of valve. [P-308(c)]

Q 4. Are any type globe valves permissible for boiler blowdown service?

A. Yes. Straightway Y-type globe valve or angle valve may be used in vertical pipes, or they may be used in horizontal runs of piping. But they must be so constructed or installed that lowest edge of opening through seat shall be at least 25% of inside diameter below center line of valve. [P-308(d)]

Q 5. What is proper sequence in opening and closing blowoff valves when blowing down a boiler?

A. When boiler is equipped with both blowoff valve and cock or quick-opening valve in same blowoff connection, always open cock or quick-opening valve first, blowoff valve second. To close, always close blowoff valve first and cock or quick-opening valve second. Caution boiler operator about opening and closing blowoff valves and cocks slowly, to reduce shocks as much as possible. (C1 520 of Sect VII)

Q 6. How much and how often should a boiler be blown down?

A. Frequency and amount of blowdown depends on many factors including: feedwater characteristics, boiler design, type of internal treatment, boiler rating and load characteristics. These vary with each individual plant.

Since purpose of blowing down a boiler is to reduce total solids content of boiler water, frequency and amount of blowdown is most effectively governed by chemical control tests.

While a full opening and closing of boiler blowdown valves once each 24 hours may be OK in certain plants, frequent short blows once each eight hours often provide improved economy and results.

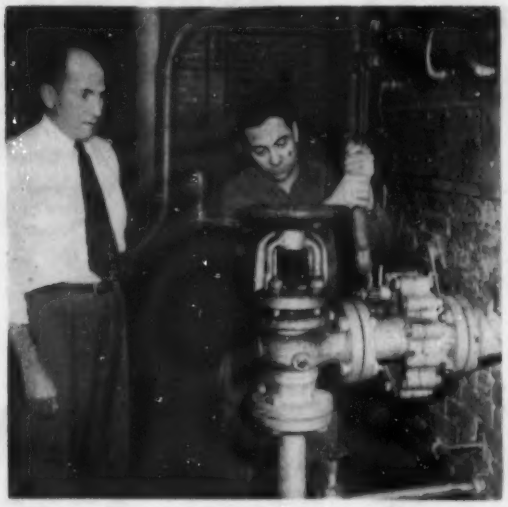
In blowing down a boiler, always be sure that normal boiler-water circulation isn't greatly upset.

Frequent internal inspections are often desirable to determine whether a specific blowdown procedure is effective, especially in areas where water is known to be unfavorable for boiler use.

Q 7. When and how often should boilers be blown down?

A. Boilers should only be blown down during period when steam production is at a minimum. Reason is that circulation in some boilers is very sensitive. Blowing down when steam production is at a maximum could upset the circulation so badly that serious damage could be done to some parts of the boiler, especially the tubes.

Blowdown valves on waterwalls serve primarily as drain valves. Never blow down waterwalls when boiler is in operation. If difficulties arise that require blowing down waterwalls, do this only



1 Inspector Todd looks on as operator gets ready. Open quick-closing valve first—slowly to reduce shock

2 With quick-closing valve open, start opening blowoff valve next. Prevent shock by opening it slowly also

3 If you can't see gage glass, station another man so he can. Never take hand off open valve, close fast

4 With blowoff valve closed tight, close quick-closing valve fast. Make sure it is fully closed as shown

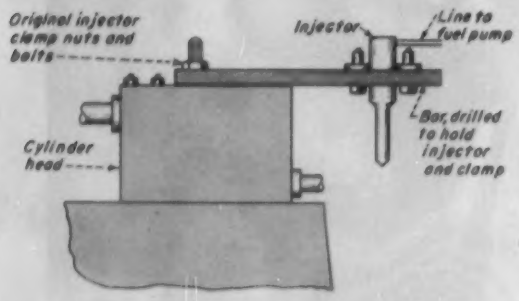
under banked conditions or only in accordance with your boiler manufacturer's instructions. (Cl 517)

Q 8. Water gage glass in some plants isn't in view of operator blowing down a boiler. Should any special precautions be taken in blowing down a boiler with this type of installation?

A. Where water gage glass is not in view of operator when blowing down boiler, station another man where he can see water gage glass and signal to operator blowing down boiler. (Cl 525)

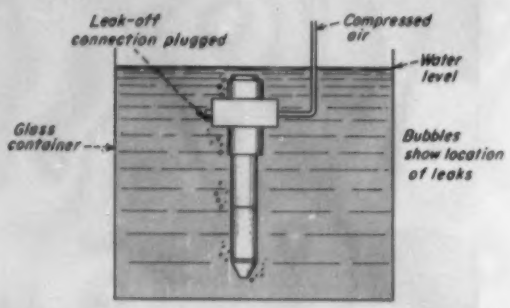
Caution boiler operators against practice of starting to blow down a boiler and then leaving boiler to do some other job, thus leaving blowoff valve open and unattended. While he may intend to return and close valve in a few seconds, it's more than likely he'll be delayed somewhat longer than this. There are cases where low-water condition has developed, causing considerable damage to boiler because operator did not return in time to close valve. Boiler operator must never take his hands off blowdown valve while valve is open. Then he can't go wrong.

Simple test stand



1 You can make this simple test stand. Use to check whether injector leaks or dribbles, to tell if it's in good shape

Testing injector for leaks



2 After reconditioning, this setup will tell whether you have any leaks at the tip or joints. Glass container is best

How to recondition diesel fuel-injection equipment

C Morgan Jones gives some easy-to-follow rules and tests that can help any diesel operator service fuel injectors quickly and easily

► THERE ARE MANY diesel fuel injectors, or fuel-injection nozzles—mechanical, hydraulic, and old-fashioned compressed-air type. And there are scores of designs. But all operate on the principle of a valve opening to admit a certain quantity of fuel into the cylinder. They must be serviced regularly for top engine efficiency.

Leaking or dribbling is one of the most troublesome injector ills. This causes crankcase dilution, detonation, heavy carbon deposits in combustion spaces, and a smoky exhaust.

Emergency measures. In an emergency, you can stop leakage through injector valves by giving the top of the valve stem a sharp tap with a hammer. If one or two taps don't stop the trouble, valve must be lapped.

Tightening injector spring adjusting screws or placing shims above or below the springs will not stop leaking. But a weak or broken spring can cause leaks. For an external leak where injector has a gland, try tightening packing nut.

Check for dribbling. To find out if an injector dribbles, place in test stand. (If you don't have a test stand, try the method shown in Fig. 1).

After priming test pump and fittings, connect piping to injector. Build up pressure to what manufacturer says it should be. If fuel accumulates in droplets on spray tip, or streams out before you reach correct opening pressure, injector needs reconditioning.

How to recondition. Remove nozzle body by taking off cap nut. If it is stuck, stand nut on a piece of wood and drive out the body using pipe drift that just fits around outside edge of the nozzle body. Be careful not to touch spray tip or pintle, as these elements break easily.

Getting valve out of nozzle body may require soaking overnight in carbon tetrachloride, acetone, fuel oil or commercial solvent. If parts fail to loosen, put unit in a bath of oil at 180-190 F, for ten minutes. Then whip out, hold in vise, apply a chunk of dry ice (held with gloves or tongs) to top of valve stem while you grip lower part with protected pliers. Lift and pull to separate the parts. If this fails, send unit back to manufacturer.

After separating parts, put the valve in a lathe or an electric- or air-driven drill chuck. Switch on motor and clean stem with a cloth or felt pad smeared with diesel lubricating oil. Don't use lapping compound or other abrasives. If carbon is hard, clean with a piece of oil-soaked soft wood or a brass wire brush.

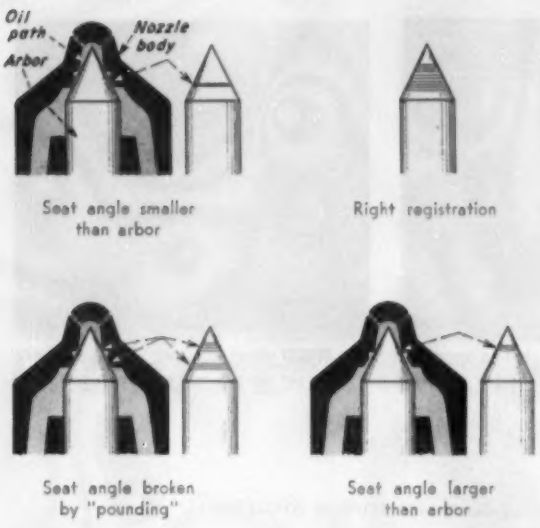
Scrape out carbon from interior of the nozzle body. Clean the valve seat with a brass, copper or wooden rod with a cone-shaped end turned to the same angle as the seat. *Note:* Get seat angle from the manufacturer. Seats and valves are often cut at different angles to provide line contact.

Next, make sure all nozzle orifices are clean. If soaking did not remove carbon, put the correct size needle for the orifice in a pin vise. Be sure vise angle is the same as angle of holes. Needle should protrude 1/32 to 1/16 in. Push it into the orifice, extending its length as it gradually enters. Blow away the loose carbon. If carbon resists, put the nozzle in a vise with protected jaws. Hold pin vise firmly and tap lightly with a small hammer.

When all parts have been cleaned, hold nozzle body at a 45-degree angle, place valve in body, then withdraw about 1/3 of its length and let go. If valve slides into place it is clean. If it doesn't, polishing is required.

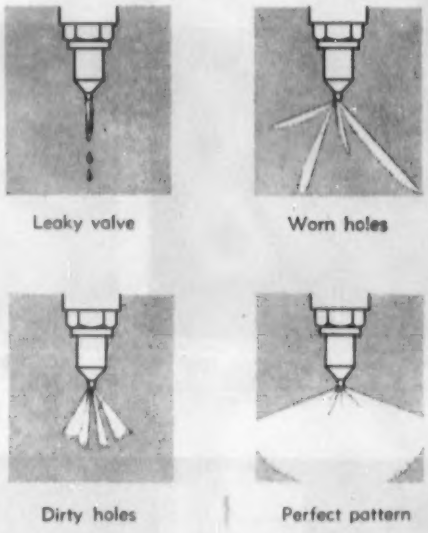
Make an extension for the valve stem by slotting a steel rod or tube to grip it. Smear the stem with oil or tallow and, holding nozzle body in vise, roll

Reading arbor markings



3 Check condition of valve seat by examining marks on the arbor during lapping. Excessive pounding shows up clearly

Nozzle spray patterns



4 Perfect spray has no flags or streamers, is not lopsided. Check pattern by holding paper under nozzle being tested

the extension rod between the palms of your hands. Renew the tallow or oil every three or four minutes. Rinse parts in fuel oil before testing for a sliding fit again.

Next, grind valve to seat. Smear valve with jewelers rouge or talcum powder and lube oil paste. Turn between your palms as before. If there is little difference in seat appearance after several minutes of rolling, valve seat is probably distorted by "pounding" and it must be lapped to shape.

Make an arbor for this job from a length of cold rolled steel with diameter slightly smaller than bore of nozzle body. Grind end to the same angle as the seat, as obtained from the manufacturer. Put the arbor in a chuck or collet where it cannot wobble. Smear arbor with a fine grinding compound and bring arbor and valve seat together. Give the chuck a few turns to spread out the compound; then, with arbor spinning at 800 to 1200 rpm, hold body firmly and bring it against the arbor. Use only enough pressure to keep the parts together, and be sure nozzle body is level.

Grind for no longer than 20 seconds at a time, so parts don't get hot. Clean after each period of grinding and check the arbor markings.

If there has been excessive pounding, contact will show at two points with a considerable distance between them (Fig. 3). But this will show that seat angle is more or less correct. If seat angle has been widened, lapping marks will be toward the point of the arbor. If valve seat is smaller than arbor, markings will be towards arbor top. A good register shows markings near the center of the taper.

If seat has been badly pounded, regrinding process will have to be repeated many times and the arbor dressed up as it wears.

Mechanical injectors can be reconditioned the same way as hydraulic ones. If valve face shows signs of pounding, i.e., if it is ridged, resurface with a lathe grinding attachment. Of course, if it is only slightly marked, relap to the seat by turning stem between the palms of the hand. Lap for five or six minutes, withdraw, clean, and if it looks good, test in stand.

If seat is damaged beyond hand repair, make an arbor from any old valve, grinding tip accurately.

Don't forget that with mechanically-operated injectors the hard and fast hydraulic rule that parts from different units cannot be assembled in one injector does not apply. All you have to do is lap the parts together until you get a good mating fit.

Test after reconditioning. When overhaul is completed, test nozzles for correct opening pressure. It's a good policy to take pressure up to about 1000 psi higher than maximum operating pressure. This will show any leaks in nozzle body and holder joints.

If you have no testing equipment, count exact number of turns and fractions of turns necessary to slacken away the spring holding plug or adjusting screw. Count shims carefully for reinstallation. After reconditioning, reassemble exactly as before, connect nozzle fuel line to high-pressure compressed air, and immerse tip in water. Bubbles will show leaks at the tip or joints (Fig. 2).

After replacing injector in engine, check exhaust temperature of its cylinder. Compare with others. Bring into line by adjusting spring pressure.

Other causes of trouble. Dirt left in cylinder head nozzle recess may prevent free heat transfer to the cooler surrounding metal. Tightening bolts unevenly may cant the injector and cause distortion. If injector seats improperly, blow-by will cause localized overheating and distortion.

Clogged orifices increase opening pressure and distort spray pattern. Firing pressure may be low, exhaust smoky, and heavy deposits of carbon may accumulate. Distorted spray can burn hole through liner, or cause irregular heating and distortion of piston crowns. Check spray pattern (Fig. 4).

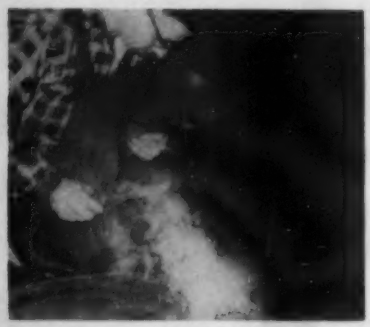
Dirty orifices, eroded orifices or noz-

(*Continued on page* 190)

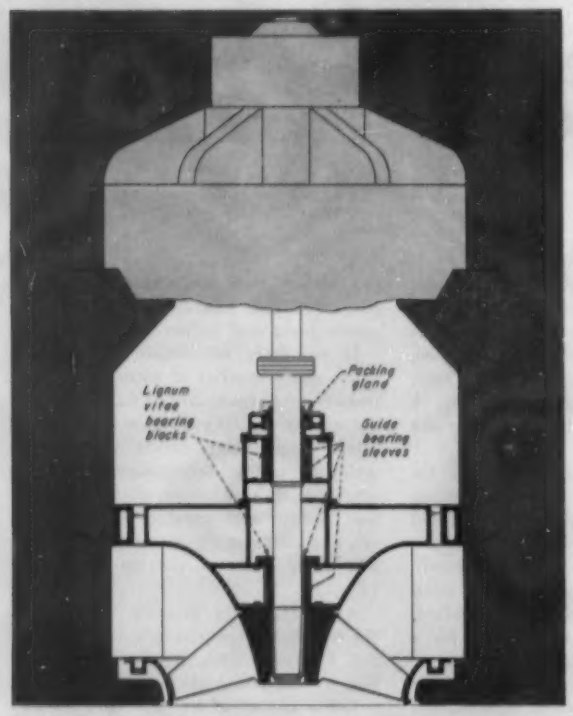
Welding stainless-steel shell around guide-bearing sleeve and then grinding not

1 **CLAMP** sheet of stainless steel to bearing sleeve before tack-welding

2 **TACK-WELDED,** with clamps removed, stainless shell is ready for welding

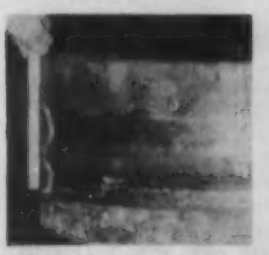


3 **WELD** sheet to shell. Take care not to set up too much heat in one area



GUIDE-BEARING SLEEVES in this turbine presented a problem

Wear and other failures



GROOVES in sleeve are from stuffing-box packing; main cause of gland leakage

FLAKING of sprayed metal is common result when the water to the bearings fails

New repair idea

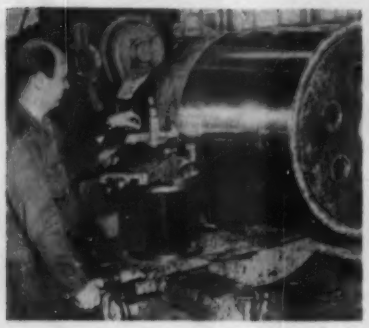
► GUIDE BEARINGS on large hydroelectric turbines keep shaft aligned. Guide-bearing sleeves provide a running surface to take wear that would otherwise occur on shaft. Wear on shaft is problem. So split-type sleeves that can be replaced quickly are usually used.

Most large modern turbines have oil-lubricated babbitt bearings. These don't need sleeves. But many older units have guide bearings, whose liners or running surfaces are lignum vitae, rubber, or Ryertex—one of the new synthetic resinous materials. This type bearing is water-lubricated. But there is always wear because of abrasives in most water.

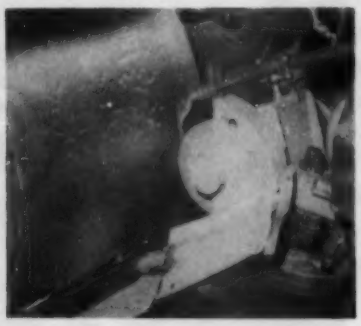
Wear. As shaft and bearings wear, a turbine shaft starts to swing or wobble. To take care of bearing wear, we keep spare bearings on hand at all Shawinigan Company stations. New lignum-vitae or Ryertex liners for our bearings are often left undersize. They can then be bored to fit the sleeves, which may, of course, wear to an under-standard diameter. If worn, but otherwise OK, we bore the bearing to fit the worn sleeve.

There are many practical short-cuts for making a quick change to lessen outage time on a large unit. For instance, sleeves have been built up oversize so a bearing that's worn oversize

only lasts much longer, but the cost isn't out of line with a metal spraying job



4 **MACHINE** to diameter needed after clamping to the halves over mandrel



5 **GRIND.** Use plenty of cooling water or heat will expand it, give trouble

6 **FINISHED JOB** and preformed sheet. Sleeve is ready to clamp on the shaft

By LLOYD McWILLIAMS *Shawinigan Water & Power Co, Shawinigan Falls, Que, Canada*

for large guide-bearing sleeves

can be kept in service. Later, a standard-size bearing is installed and sleeves again made standard by turning them down. But some maintenance men don't like this practice for obvious reasons.

Grooving. You must do something when guide sleeves become badly grooved and scored or when they develop flats. But a set of sleeves cost several thousand dollars. So you must try to extend their usefulness.

When metalizing first came in maintenance men quickly used it to reclaim sleeves by building them up with an overlay of sprayed metal. Stainless steel was sprayed over mild steel of sleeves on most rebuilt jobs. Bronze has also been used for this purpose.

Many such rebuilt sleeves have stood up for about ten years. But with time and use, there is a tendency for the sprayed metal to lift and peel off. Examination showed this was caused by rust developing between sprayed metal and original body of metal, thus destroying bond. Another very serious weakness with metalizing is bearing failure caused by running short of lubricating water for some reason.

New method. While ten years service is very good for such a job, it's only natural to try to find a better method for prolonging life of these sleeves.

Last year a set of sleeves needing repair arrived in our shop. Sleeves had been metalized. After some brainstorming, we tried an entirely new approach to this problem. Since stainless steel is without question the superior metal for such duty, we tried preformed stainless-steel shells, then welded them to mild steel of sleeves.

First, we rolled No. CF-10-M (KSMO) ¼-in. stainless sheet into cylindrical form, allowing some overlap. Faulty sleeves were then clamped over a mandrel, set up in lathe and turned down to a predetermined diameter to take the stainless shells. This diameter varies on different jobs, depends on amount of wear. We felt ¼-in. sheet was thick enough to compensate for wear on this first job, allowing enough material for machining and finish grinding. On recent jobs, we have increased this to 5/16-in. and ⅜-in. sheet, getting even better results.

After machining, sleeves were removed from lathe, then split. Cylindrical shells were cut into halves and firmly clamped to each half sleeve, photo. Then spot-welding followed. During final welding, we prevented warping by taking great care not to set up excessive heat in a particular area. You might as well know that because of dimensions, welding gave us our greatest concern. Reason is these sleeves have 32-in. outside diameter, 28-in. inside diameter and are over 30 in. long.

Fortunately, we had no trouble. As photographs show, all edges were welded, idea being to keep water from entering space between sleeve and shell. Incidentally, for insurance we applied a liberal coat of red lead to sleeve before clamping shell into place. This may not be necessary. Twelve ⅝-in. equally-spaced holes were drilled through faces of each half sleeve after shell was in place. These holes were then "plug-welded." Welding was for additional bonding and strength.

Machining gave no trouble as we used a Carboloy tool. Grinding did offer a problem because there was expansion from heat caused by grinding wheel. We overcame this, photo, by placing a large pan under work and directing a stream of water on work. At the same time we immersed lower portion of sleeve in water.

Several sets of sleeves have been revamped by this method since our first try. In one case stainless-steel shells were successfully welded to a set of bronze sleeves. Strange as it may seem, costs of such a repair compares favorably with our former method. Also, engineers who designed our turbines approve this method.

ELECTRICITY

It pays to rebuild large motors ... sometimes

By R L GEHRING, *Mgr Parts Dept*
Electric Machinery Mfg Co

NEW INSULATING MATERIALS, either *Class B* or *H*, can be used to permit a higher temperature rise. This factor alone can step-up motor hp or solve a tough ambient temperature problem. Old motor coils, above, are being lifted from stator slots

► EVERYDAY POWER MEN weigh the problem of building an old motor against ordering a new one. Often the old unit can be rebuilt at far less cost and delivered in shorter time. Consider rebuilding where: (1) present motor has "worn out" or failed in service (2) new loads outstep capacity of existing motor (3) environment change affects motor operation (4) surplus equipment is available.

A case in point. Insulation on a 1100-hp, 120-rpm synchronous motor was brittle. Unit had been operating 24 hrs daily since the early '20's. After checking with motor manufacturer, the 60-pole rotor was shipped back to factory where field coils were reinsulated. Stator, having a 160-in. back bore, was rewound in the user's plant. With exception of armature coils and field coil insulation, all motor parts were salvaged. *Bill came to 40% the cost of a new motor and job was done in 3 weeks instead of the 4 months plus required for a new motor.*

More hp needed in a given machine or a change in motor's ambient conditions can often be handled best by rebuilding. Hp ratings can sometimes be stepped up by rewinding motors with *Class B* or *H* insulation. (Ed Note: See POWER, June 1955, pp 82-85). Example: A Southern chemical plant had 6 vertical synchronous motors rated 300 hp each, driving sea water pumps. Plant production needs called for stepping up output to 450 hp per motor. If new motors were selected cost of reinforcing underwater foundation alone was estimated at ½ million dollars. *Class H* insulation solved this problem by increasing allowable temperature rise of motors to point where they could develop the 450 hp easily. Silicone *Class H* offered an added bonus in resistance to salt air and a generally longer life expectancy than *Class A*.

Surplus motors are sometimes on tap, and with some modification they often fill the bill. Take the West Coast pulp and paper mill that wanted to install 3 pulp-grinder motors. Power man in charge spotted 3 units taken out of service in a Midwestern mill. However the "new" motors were engine type, lacking shaft, bearings, base and rated at higher voltage but lower hp than required for job at hand.

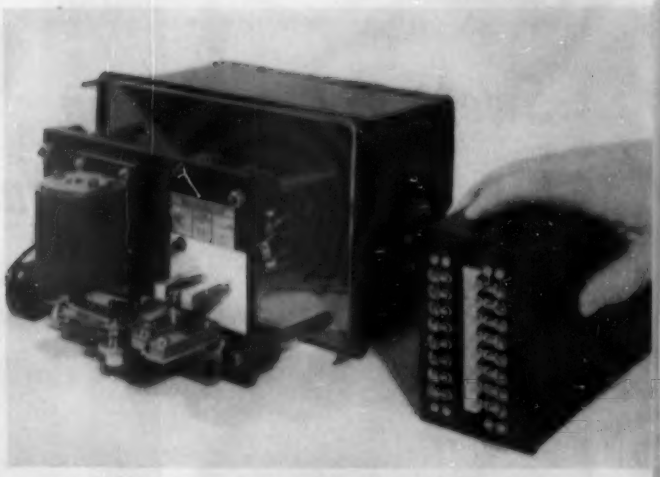
After voting in favor of rebuilding, the stator and field were rewound to new operating voltage and output increased to 2800 hp each. Shaft, bearings, and base were added. *Rebuilt units were installed for less than half the cost of new motors.*

What can be done at lowest cost is best worked out between yourself and motor manufacturer. Since unit was originally his baby, he probably still has drawings and patterns used to build it. Manufacturer's design staff can straighten you out on limitations and capability of equipment and suggest recently developed materials that might be used.

Typical changes would include decreasing voltage, adopting newer type insulation, increasing number of damper bars, adding to enclosure, replacing collector rings and brushholders. New parts, such as shaft, bearings or base, can be added to engine-type motors. Since going to higher voltages calls for greater insulation thickness than slot size may hold, it is usually impractical to increase voltage rating unless core is replaced, assuming conductor size remains the same.

Special insulation treatment can be given to resist alkalis, moisture, carbon black or other contaminants. Damper bar material may be changed or a double end-ring used in place of a single to dissipate heat more readily under prolonged starts. Motor's starting torque, pull-in or pull-out torque may be altered by changing number or composition of damper bars.

Magnetic amplifier trims maintenance of voltage regulators



OLD AND NEW voltage regulating elements for step and induction units. Absence of moving parts promise fewer trouble calls

► A NEW CONTROL promising minimum maintenance has been developed for induction and station-type step regulators and tap-changing-underload transformers. A magnetic amplifier does the job formerly handled by moving parts. When Westinghouse took the wraps off this new development, two of their engineering managers, J H Chiles Jr and A M Harrison stressed, that in addition to providing increased reliability, the controls allow operator to make all control settings from front of panel. This means that it's now practical to use a semi-skilled man where a top test man was previously needed—and with less chance for error. Function of the control remains the same: to maintain voltage within set limits at some point in the distribution system.

Magnetic amplifiers were doing a power amplifying job when vacuum tubes were in their infancy. They have been used for sometime to control theatre lights, mercury-arc rectifier-firing circuits, motor starters, battery chargers and resistance furnaces. In the '40's, better core materials and dry-type rectifiers proved a stepping-stone in permitting magnetic amplifiers to take on even more important control functions.

Early applications in industrial plants saw magnetic amplifiers applied to a tension regulator in the paper making business in 1949, and on a brass mill reel-tension regulator in 1952. In the summer of 1952, Westinghouse applied a magnetic-amplifier regulating system to excitation control of large synchronous generators. (POWER, Oct 1953, pp 116-117). Introduction of a static control for voltage regulators at this time tied in with industry's need for close voltage check on feeder circuits and the power man's desire to trim maintenance costs.

Voltage-regulating element is brains of the control system since it directs all control operations. Present control schemes use some form of an electro-mechanical voltage regulating element made up of either a solenoid or induction disk. The element has a bandwidth setting that determines voltage spread of regulated system. It operates to energize time-delay element every time voltage swings outside set bandwidth. If feeders have fluctuating voltage because of nature of load, it will mean excessive operations of conventional regulating relay. This leads to a short life and affects reliability of entire control system. Time-delay element limits excessive operations of the tap changer.

Only the voltage-regulating and time-delay elements in the control are subject to possible excessive operation. In comparison, motor contactor seldom operates. So static devices that perform both functions will save many trouble calls and increase system reliability.

STATION-TYPE STEP REGULATOR control panel with new scheme, permits making settings with dials on front of board

Sweat-saving tips on repainting transformers

CHEMICAL REMOVER bubbles-off old paint. Apply until all the tubes are clean

DISTRIBUTION transformers, regulators, capacitors best handled by a spray gun

PAINT VISCOSITY should be checked during mixing and periodically during painting. To do this, dip a Zahn viscosimeter into paint and start timing as it breaks surface

FLOW METHOD is generally best suited for painting self-cooled and fan-cooled power transformers. This method has proven tops for covering hard-to-get-at radiators

► ALL TRANSFORMERS must be repainted periodically because of normal deterioration from exposure to the elements. If right materials are selected and right methods followed, a fine job at reasonable cost can be obtained.

Surface preparation is first step. All loose paint, scale, blisters, rust, oil, grease and moisture must be removed. If tank is in generally bad shape, remove all of the old paint. Use either chemical or mechanical means to do the job. Mechanical methods — grit, shot or sand blasting—do a thorough job of removing all paint, rust, dirt. Take care to mask all porcelain bushings so blasting doesn't damage glaze. Seal all openings around tap-changing equipment.

Chemical paint removers — strong solvents or alkalies—are usually best for removing paint from tubular or radiator-type transformers. Removers are generally applied by flow method, similar to flow technique for painting described below. After unit is rinsed with clear water, wire-brush, and treat with solution of 3 grams of potassium dichromate per gallon of water or a like neutralizer. You're now ready for the priming coat.

Spraying is generally most effective method of repainting units without tubes or radiators. Use an external-mix spray gun. *Flow-method* is best bet for power transformers of self-cooled or fan-cooled types. Suggested equipment for flow-painting include sheet metal pans with flared edges to catch excess paint flowing off radiators and tank and which at the same time serve as a paint reservoir; gear pump with pressure adjustment system; length of neoprene hose; some ½-in. aluminum tubing. Flatten the end of tubing so paint comes out in a sheet rather than a stream. *Caution*: Remove all fans and paint them individually. In this way care can be taken so paint is applied evenly, preventing unbalance.

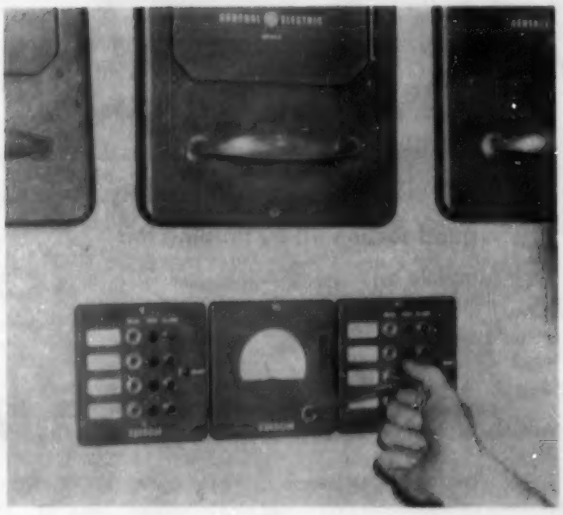
Brushing is seldom used today to paint complete power transformers; takes too long.

Paint preparation generally boils down to a viscosity-determination. For spraying, thin paint to 14-17 seconds on the Zahn #3 viscosimeter. If flow-painting, thin to 20-25 seconds on the Zahn #2, see photo. Number of coats required is generally up to your own discretion. If transformer is merely chalked but not rusted or flaked, a finish coat may do.

The above is a summary of the facts as presented in General Electric's new bulletin "Repainting Transformers In the Field." For the full story write to General Electric Co, Schenectady 5, N. Y. Ask for Bulletin GET-677F.

Hot bearing... alarm sounds...

...fast check



► TEMPERATURE is a critical factor in many industries today. Typical situations are where power is generated, chemical processes are in motion, key machinery is operating. With wage levels on the increase, power men are sharpening their operating pencil and scrutinizing ways to save on manhours.

Power men at the English Station of the United Illuminating Co in New Haven, Conn, recently decided on an automatic temperature monitoring system for their No. 8 turbine-generator. This installation consists of eight separate points and a temperature indicator so each point can be measured from the central-control room. Eight detectors for the system are installed on the turbine-generator and serve to check lube-discharge temperature from eight bearings. Four temperatures are from main bearing, two from thrust and two from exciter.

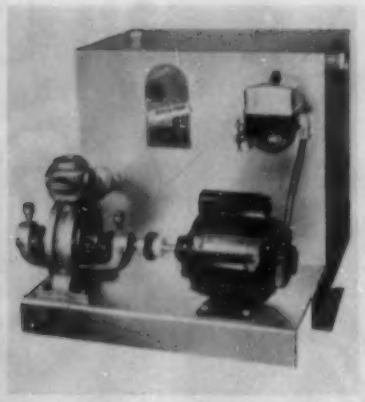
When oil temperature of any of these bearings reaches 150 F, the associated panel light indicates which bearing is overheating. Simultaneously, a buzzer sounds to warn operator on duty. Detector sticks directly into the oil bath. Accuracy check is maintained by comparing detector results with a mercury thermometer. Operating data shows control room reading is within 1 deg of temperature measured by the mercury thermometer.

System this plant chose is made up of monitor units assembled on a building-block principle. Plug-in units are grouped according to specific needs. Units of this system can be added, deleted or switched to other plant equipment without disturbing system.

Although there are sound arguments for having men periodically "make the rounds," trend is the other way. Too many manhours are wasted every day by men reading thermometers or feeling bearing casings scattered over a wide area. Today automatic monitors are available to do these jobs economically and often more dependably and accurately. Monitors watch temperatures at distant, dangerous and often inaccessible spots.

Actually, a good monitoring system suggests the possibility of increasing peak loading safely, and maintaining peak longer, since warning is given before temperature reaches a dangerous level. Monitors, along with closed-circuit TV (see POWER, April 1953, p 78) are shaping up as low-cost insurance against production losses and equipment damage. Initial cost of both a wired monitor system and industrial TV is reasonable since you buy only the number of units needed: More points (or cameras) can be added later.

1 Elevated tank for this return pump insures good suction-head condition

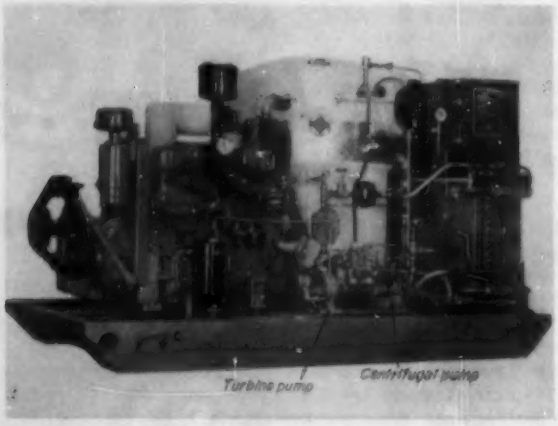


2 Package-type condensate-return unit is automatically started and stopped

3 Belt-driven turbine pump often used as a circulator in hot-water systems

By E L ABRAMSON, *Chief Engineer, Turbine Pump Dept, Aurora Pump Div, The New York Air Brake Company*

For boilers, cooling towers, hydraulic systems and other plant jobs you can secure steep head-capacity, good suction lift by reading this article on . . .



7 Distillation unit used by the Army during World War II has two pumps, one turbine and one centrifugal for feed

How to use the turbine pump for

► EARLY TURBINE PUMPS found many jobs in returning hot condensate from heating systems to the boiler. Because their popularity for this use grew rapidly, standard assemblies of a tank, float switch, motor and turbine pump are now available for condensate-return service. Fig. 2 shows a package-type unit. Float-operated switch in the tank automatically controls motor, starting it when water level in tank rises to a certain height. Switch stops motor when tank level reaches a low point, fixed by switch setting.

Duplex units. In installations where standby protection is needed, a second unit with a separate float switch is added to the assembly, Fig. 8. Both pumps may run at the same time to handle excessive amounts of condensate returning to the receiver tank. Or the pumps may be run alternately, with one unit always available for emergency needs.

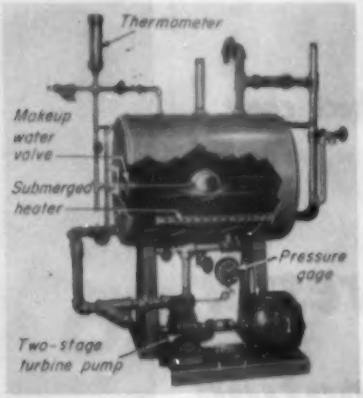
Some jobs require a vertical type of condensate-return unit, with the pump in a tank below the floor level, and the motor and controls above the floor. Designs of this type are also available.

Fig. 4 shows another popular type of condensate-return unit used in many building installations where return lines are close to the floor. Until recently, pressure requirements in small heating plants seldom exceeded 15 to 20 psi, and centrifugal pumps were generally used for condensate return. Today, pressures often run as high as 50 psi and the high-pressure characteristics and small size of the turbine pump make it ideally suited for this class of service.

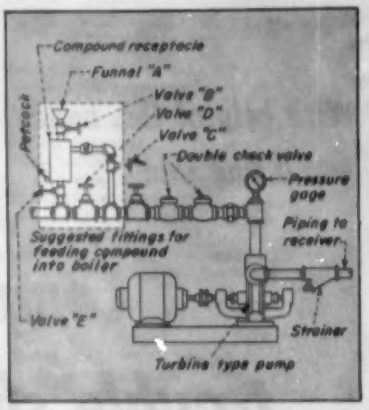
Boiler return systems require the same type of pump characteristics as condensate-return units—ability to handle hot water against pressures up to 200 psi. Boiler return systems are widely used in laundries, dry-cleaning plants, dairies, creameries, and many other jobs where steam is needed for process work.

Since large amounts of steam may be exhausted to the

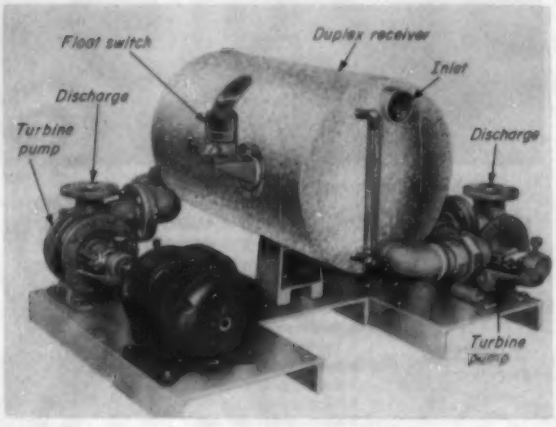
4 Condensate-return unit popular for jobs where lines are close to floor



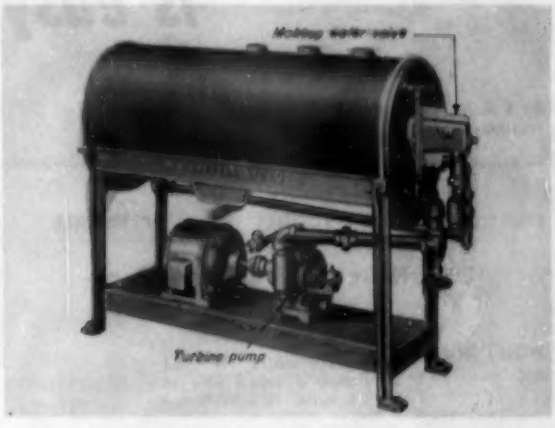
5 Boiler return system with 2-stage turbine pump; steam heater in tank



6 Piping hookup for feeding chemicals into the discharge of a feed pump



8 Duplex condensate-return unit is arranged so both pumps can run together or separately, giving standby service



9 Packaged-type boiler return system has turbine pump and automatic makeup valve, is controlled by boiler level

condensate-return and hot-water jobs

atmosphere, provision is made for adding makeup water to the system. This is accomplished by a special valve installed in the tank and connected to the city-water-supply line, Fig. 9. A float in the tank automatically opens or closes this valve, depending on the amount of water in the tank. Level of the water in the boiler controls pump operation, instead of the tank water level. Liquid-level controller on boiler often incorporates a low-water alarm.

Fig. 1 shows another boiler return system using a turbine pump. Tank is elevated above pump. This type is used where the condensate returns at close to its flash point.

A third type has a 2-stage turbine pump for pressures of 75 to 200 psi, single-stage pumps being used below 75 psi. Fig. 5 shows a typical 2-stage unit. Heater in receiver and automatic makeup are features of this unit. Packaged boilers generally use a turbine pump for feed service.

Distillation units, Fig. 7, of the portable type find use in the military. Unit shown is fitted with a turbine pump. This type pump is also used for boiler feed in many plants.

Feedwater treatment. Fig. 6 shows a good hookup for introducing boiler compound into the feedwater. During normal operation, valve *D* is open, *C* and *E* are closed. When compound is to be added, valve *B* is opened and the compound receptacle drained through the petcock. After the petcock is closed, compound is poured into the receptacle through funnel *A*. Valve *B* is closed, valves *C* and *E* opened, and *D* closed.

This procedure correctly introduces compound into the discharge line, from where it flows to the boiler. Normal flow is restored by opening valve *D* and closing *C* and *E*.

Hot-water circulation is another application using turbine pumps. Unit may be direct- or belt-driven. Fig. 3 shows a small turbine pump frequently used for this service. It is fitted with a mechanical seal and is belt-driven.

With help of this handy check chart you'll find that . . .

Compressor trouble shooting is easy

By E A MURRAY and W H WHEELER,
Worthington Corporation

Water-cooled compressors

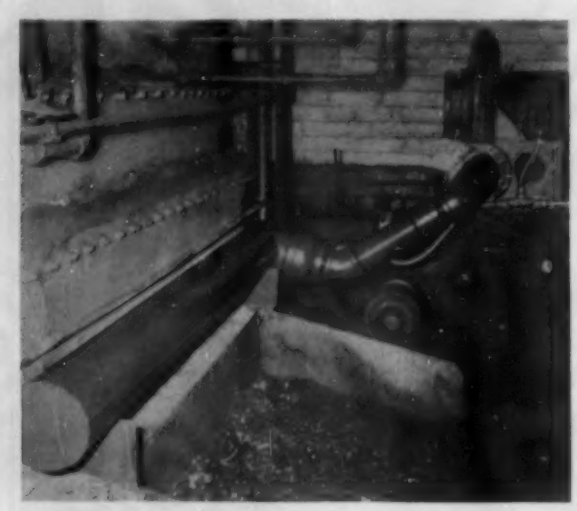
SYMPTOM	POSSIBLE CAUSES OF TROUBLE
WON'T DELIVER AIR	1 Restricted suction line 2 Dirty air filter 3 Valves missing 4 Worn or broken valve strip 5 Defective capacity control
CAPACITY TOO LOW	1 Clogged suction line 2 Dirty air filter 3 Loose valve 4 Worn valves 5 Defective unloaders 6 Wrong speed 7 Worn piston rings 8 Leaky head gaskets 9 Poor capacity control
PRESSURE TOO LOW	1 Valves missing 2 Strips missing from valves 3 Worn valve strip 4 Loose valve 5 Worn valves 6 Unloaders defective 7 Excessive system leakage 8 Wrong speed 9 Worn piston rings 10 Leaky head gaskets 11 System demand greater than compressor capacity 12 Defective capacity control
COMPRESSOR OVERHEATS	1 Worn valves 2 Wrong speed 3 Poor capacity control 4 Not enough cooling water 5 Cooling-water temperature too high 6 Discharge pressure too high 7 Inadequate cylinder lubrication 8 Motor too small 9 Belt too tight
COMPRESSOR KNOCKS	1 Loose valve 2 Loose unloader 3 Discharge pressure too high 4 Inadequate cylinder lubrication 5 Inadequate running gear lubrication 6 Loose flywheel or pulley 7 Excessive bearing clearances 8 Misalignment 9 Loose piston-rod nut 10 Loose motor rotor on shaft 11 Loose crosshead shoes
COMPRESSOR VIBRATES	1 Defective unloaders 2 Excessive system leakage 3 Discharge pressure too high 4 Loose flywheel or pulley 5 Loose motor rotor on shaft 6 Bad foundation 7 Poor grouting 8 Wedges left under compressor 9 Misalignment 10 Piping improperly supported
INTERCOOLER PRESSURE TOO HIGH	1 Strips missing from valves in h-p cyl 2 Worn or broken valve strip 3 Loose valve in h-p cyl 4 Worn valve in h-p cyl 5 Defective unloaders 6 Worn piston rings in h-p cyl 7 Poor capacity control on h-p cyl
INTERCOOLER PRESSURE TOO LOW	1 Valves missing 2 Strips missing from valves in l-p cyl 3 Worn or broken valve strip 4 Loose valve in l-p cyl 5 Worn valve in l-p cyl 6 Defective unloaders in l-p cyl 7 Worn piston rings 8 Leaky head gaskets 9 Defective capacity control in l-p cyl

SYMPTOM	POSSIBLE CAUSES OF TROUBLE
RECEIVER PRESSURE TOO HIGH	1 Defective unloaders 2 Poor capacity control 3 Poor capacity-control adjustment
DISCHARGE AIR TEMPERATURE TOO HIGH	1 Worn valves 2 Defective unloaders 3 Defective capacity control 4 Poor capacity-control adjustment 5 Not enough cooling water 6 Cooling-water temperature too high 7 Discharge pressure too high 8 Poor cylinder lubrication 9 Intercooler pressure too high 10 Dirty intercooler 11 Dirty cylinder jackets
COOLING-WATER DISCHARGE TEMPERATURE TOO HIGH	1 Worn valves 2 Defective unloaders 3 Not enough cooling water 4 Cooling-water temperature too high 5 Discharge pressure too high 6 Poor cylinder lubrication 7 Intercooler pressure too high 8 Dirty intercooler 9 Dirty cylinder jackets
MOTOR FAILS TO START	1 Defective unloaders 2 Poor capacity control 3 Wrong electrical characteristics 4 Motor too small 5 Belt too tight 6 Voltage too low 7 Excitation incorrect 8 Motor overload relay tripped
MOTOR OVERHEATS	1 Wrong speed 2 Poor capacity control 3 Discharge pressure too high 4 Poor cylinder lubrication 5 Poor running gear lubrication 6 Belt too tight 7 Voltage too low 8 Excitation incorrect
SYNCHRONOUS MOTOR FAILS TO START	1 Defective unloaders 2 Poor capacity control 3 Wrong electrical characteristics 4 Voltage too low 5 Excitation incorrect 6 Motor overload relay tripped

Air-cooled compressors

SYMPTOM	POSSIBLE CAUSES OF TROUBLE
PRESSURE TOO LOW	1 Excessive leakage in air lines, fittings, valves 2 Worn piston and rings 3 Demand greater than unit capacity 4 Wrong speed
COMPRESSOR OVERLOADS MOTOR	1 Restricted discharge line 2 Insufficient lube oil 3 Control line leak 4 Defective switch, or trigger valve set for too high a cut out 5 Belt too tight 6 Compressor or motor binding 7 Electrical-power characteristics incorrect 8 Voltage too low 9 Discharge pressure too high 10 Wrong speed
INSUFFICIENT CAPACITY	1 Suction line blocked, dirty filter 2 Suction valve unloaders stuck in unloaded position 3 Excessive leakage in air lines, fittings, valves 4 Leaking intercooler 5 Valves not installed right 6 Strips missing from valves, or broken 7 Worn piston and rings 8 Blown cylinder-head gasket 9 Belt slipping 10 Demand greater than unit capacity 11 Discharge pressure higher than rating 12 Wrong speed
COMPRESSOR OVERHEATS	1 Suction line blocked, dirty filter 2 Insufficient lube oil 3 While running loaded: Broken or leaking h-p suction-valve strip, h-p unloader stuck in unloaded position, blown h-p suction valve seat 4 Control line leak 5 Valves not installed right 6 Strips missing from valves, or broken 7 Wrong speed 8 Wrong direction of rotation
COMPRESSOR KNOCKS	1 Loose valve 2 Not enough lube oil 3 Valves not installed right 4 Strips missing from valves, or broken 5 Motor rotor shunting back and forth, due to belt misalignment or mounting not level 6 Wrong direction of rotation 7 Loose flywheel or pulley 8 Too much wrist pin and bushing clearance 9 Main bearings need adjusting 10 Too much crank-pin bearing clearance
COMPRESSOR VIBRATES	1 Piping not supported right 2 Motor rotor shunting back and forth, due to belt misalignment or mounting not level 3 Motor rotor out of balance 4 Unit not properly secured to foundation 5 Defective foundation 6 Shipping block not removed under base
INTERCOOLER VALVE BLOWS	1 While running unloaded: Broken or leaking h-p discharge-valve strip, h-p unloader leaking air, blown h-p valve gasket 2 While running loaded: Broken or leaking h-p suction-valve strip, h-p unloader stuck in unloaded position, blown h-p suction valve seat 3 Defective or improperly set safety valve
RECEIVER SAFETY VALVE BLOWS	1 Leak in control line 2 Defective or improperly set safety valve 3 Pressure switch differential too narrow
UNIT BLOWS FUSES	1 Discharge line restricted 2 Not enough lube oil 3 Pressure switch differential too narrow 4 Compressor or motor binding 5 Defective motor 6 Fuses too small 7 Electrical-power characteristics incorrect 8 Unit starting against full load
EXCESSIVE OIL CONSUMPTION	1 Suction line blocked, dirty filter 2 Oil level too high 3 Oil viscosity too light 4 Oil pressure too high (if force-feed lubrication) 5 Worn piston and rings

PRACTICAL IDEAS ... *any one of these tips*



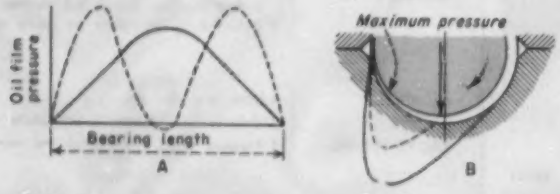
Chief Rethman reports '*no smoke*' with overfire air in furnace

BOILER SHOWN HAS overfire air for smoke control, also for boosting boiler capacity. Installation is last of three at Dinkler-Tutwiler Hotel, Birmingham, Alabama. Each boiler has about 1500 square feet of heating surface—all fired with spreader-type coal stokers. Load is mostly heating and hot water, except one 80-hp laundry installation.

Overfire-air system has a pressure-type blower, discharging into a manifold placed on boiler front. Injection nozzles tipped with cast-iron venturi outlets discharge at a downward angle into the firebox. Blower operates automatically with a mercury switch on modulating control shaft of stoker. On low fire there's no need for additional air or turbulence furnished by overfire-air system. Such air at this time would simply dilute gas and cause an inefficient condition in firebox. With increase in feed rate by movement of modulating feed-control shaft, overfire-air fan is set to come on at most desirable point in the upward swing of the stoker arm.

Overfire air on this job has upped steam capacity by about 20% and has eliminated smoke to point where there's no objection from Smoke Abatement Department of city. Prior to installing system, smoke was very bad on high fire. Two boilers had to carry load even in mild weather. Now one boiler carries load most of time, saving considerable coal. Fuel is high-grade double-screened bituminous stoker coal.

E T DOUGLASS, JR
Birmingham, Ala.



Remember these bearing-groove pointers

PROBLEM is to groove large horizontal-joint, slow-speed, babbitt bearing in steel mill, POWER, Dec, p 143. Bearing load reverses and its direction is near top horizontal joint, with gravity oil fed from top.

Grooves shouldn't extend across any part of bearing surface subjected to oil-film pressure. Grooves in this pressure area would allow oil to follow path of least resistance, preventing oil film from carrying load.

Use oil grooves only in bearings operating all or part time with thin-film lubrication. These are bearings that have oscillatory motion where relative speed between the bearing and journal is low.

Bearings of thick-film lubrication with grooves in high-pressure region are harmful. They prevent continuity of film, which may lead to thin-film lubrication. Sketch *A* shows lengthwise pressure distribution with oil groove cut around middle of bearing (circumferential groove). Longitudinal groove at maximum pressure point is more harmful, sketch *B*.

Solid lines in sketch *A* show lengthwise pressure distribution for a bearing without grooves. Dotted line show pressure gradients for bearings having circumferential groove. So grooves provide easy exit for oil as it's forced into pressure area. This lack of resistance to oil flow prevents (1) building up hydraulic pressure in film (2) floating the journal. Metallic friction, wear and power loss result.

Journal. Don't cut groove into journal, but into surrounding bearing. Often

longitudinal groove along top is used, but groove inclining from oil hole in direction of journal rotation is best. Groove should not extend to ends of bearing, unless bearing is ring-oiled and leakage at ends is free to drain to housing well for recirculation.

With 2-part bearings, longitudinal groove may be formed along each side by chamfering edges of cap and base, but not of entire length.

With gravity feed, oil should enter on low-pressure side. If journal is carrying load, a point of entry at bearing top is OK. For pressure-lubricated systems, oil should enter adjacent to high-pressure area on in-feeding side toward which journal surface is running. With reversing load having oil-film pressure acting upward, avoid vertical downward feed because resulting pressure direction displaces lubricant.

H B WAYNE *Brooklyn, N. Y.*

Wrap barbed wire around straw to clean water main

LARGE CHEMICAL WORKS had problem of frequent main cleaning. But metal cleaning device forced through the pipes by water pressure would not go round sharp bends. So bends had to be removed for cleaning. Metal mouse used for forcing through pipes was finally replaced by one of same size, but made of straw and wrapped on outside with barbed wire.

This new device is forced through pipe by water pressure. It is flexible enough to go around bends, while barbed wire cleans pipe walls of all sediment. It works surprisingly well.

W E WARNER
Woodford Green, Eng.

Now air nozzle is easily found

WE HAVE a compressed-air hose with an air nozzle. Hose is used to blow dirt or metal chips, to clean gasoline or oil lines, etc. Hose space was usually in a state of confusion because air nozzle never seemed to be on top of hose reel.

Time and tempers were lost while trying to find the air nozzle. Then we painted a 4-foot section of air hose near air-nozzle connection. Bright color now helps user spot air nozzle. He quickly pulls at painted part to get the nozzle. Rest of hose is left undisturbed.

A R TANNER, JR.
Cold Springs, N. Y.

What would you have done?

I TOOK CHARGE of a public building that had no tools except hammer, hacksaw and two monkey wrenches. And there were no spare parts of any kind. Building was opened by 9 am each morning. One day, about 7:45 am, I noticed the discharge line from relief valve on hot-water tank was discharging water in great amounts. Volume was so large sump pump couldn't lift water to sewer 16 feet above sump.

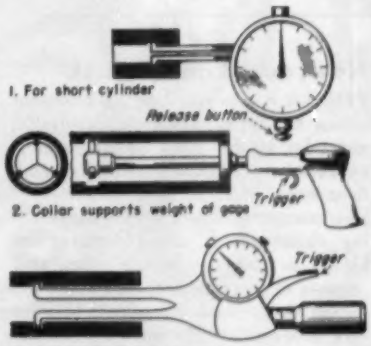
Water-pressure gage showed pressure was normal. I then tried closing tank shutoff valve, but it didn't hold. Finally, I stopped flow by closing the house water-main valve. After further checking and removing bonnet of relief valve, I found adjusting nut was screwed down as far as it could go. Trouble was that part of tension spring had eroded, weakening spring so valve leaked.

New relief valve was the answer, but getting it would take a few hours. And building had to be ready for service in an hour. I could remove relief valve and plug line temporarily until I got a new valve. But there were no parts or fittings in our building, and local supply stores didn't open till 9 am. So I couldn't get a plug either.

Solution was to find steel washers. After cutting them into horseshoe washers with a hacksaw, I placed them on stem between tension spring and bonnet body. I put relief valve together and opened water service. Relief valve held tight until I was able to buy a new one that afternoon. What would *you* have done?

L M MARTINEZ *Rego Park, N. Y.*

Check O-ring grooves with these instruments



HERE ARE three gage types to check O-ring grooves and ID's of tubes. Many O-rings have a small width.

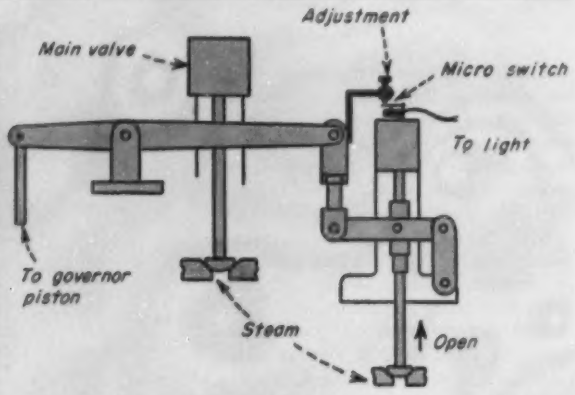
That means you may need specially shaped contacts on two of the gages shown. Gage No. 2 is used if (1) length of tubing to explore is great or (2) O-ring groove is at a distance where other tube gages cannot reach it and still maintain accuracy. After using one of these three gages, you will have the correct ID of O-ring groove. This enables you to order correct O-rings, helps eliminate one of the problems of this ring.

B A CROSSON *Cranston, R. I.*

(*Continued on page* 128)

More PRACTICAL IDEAS

Begins on page 126



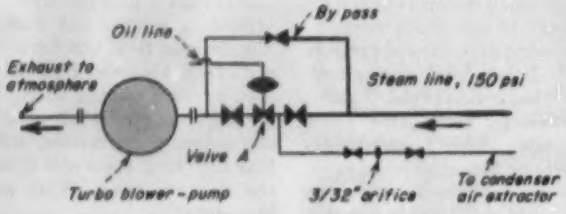
Now, overload valve is wired to show us that it's open

WE HAVE a 15,000-kw turbine generator that can carry 18,000 kw, or better, before overload valves open. Incremental heat rate of machine increases rapidly after overload valves open. Since we are part of an interconnected system, we are base-loaded most of time.

There are times when we burn 100% gas fuel. That makes it more economical to generate kw's than coal-burning plants in our system, up to point where turbine overload valves open. I have mounted microswitches on overload valve to light a bulb on top of machine, thus indicating any opening of valve.

We now load machine until the light goes on. Then we back it off until light goes out, and operate machine at maximum loading without overload valves opening. There's no guesswork now!

C J WERDERITCH *Clinton, Iowa*



No more water hammer since using orifice

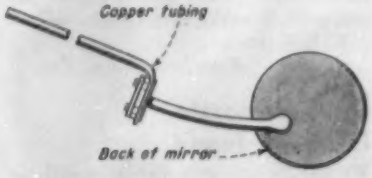
WE HAD PROBLEM of water hammering when auxiliary lubricating oil-turbine-driven pump went into operation. Remedy was ½-in. bleed line with a 3/32-in. hole in orifice, sketch. Heavy lines in sketch were also pitched toward valve *A*. Now, water hammer is gone.

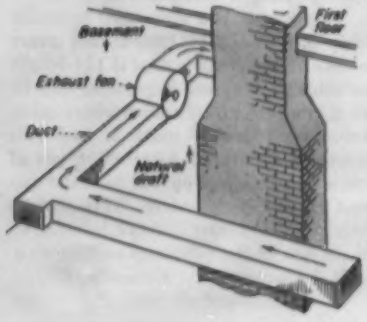
D W ANTONACCI *Bolivar, Pa.*

Grounding pulley

BEST WAY to prevent static is to mount a carbon brush so that it bears on the pulley face. Connect brush to a good ground. If the pulley and brush faces are kept clean, and brush is under proper spring tension, pulley is kept at earth potential and there will be no sparking. This is very important.

W E WARNER
Woodford Green, Eng.





Now, odors go up stack

PROBLEM WAS to ventilate two basement rooms for animal research. Naturally, any odor is obnoxious to personnel if exhaust is at either basement or second-floor level. Since building had recently been connected to main steam line, existing chimney was of no further use. Using the chimney, sketch, eliminated expense of carrying ductwork above the second floor. Stack turned out to be a very economical solution to problem.

B A CROSSON *Cranston, R. I.*

See around corners

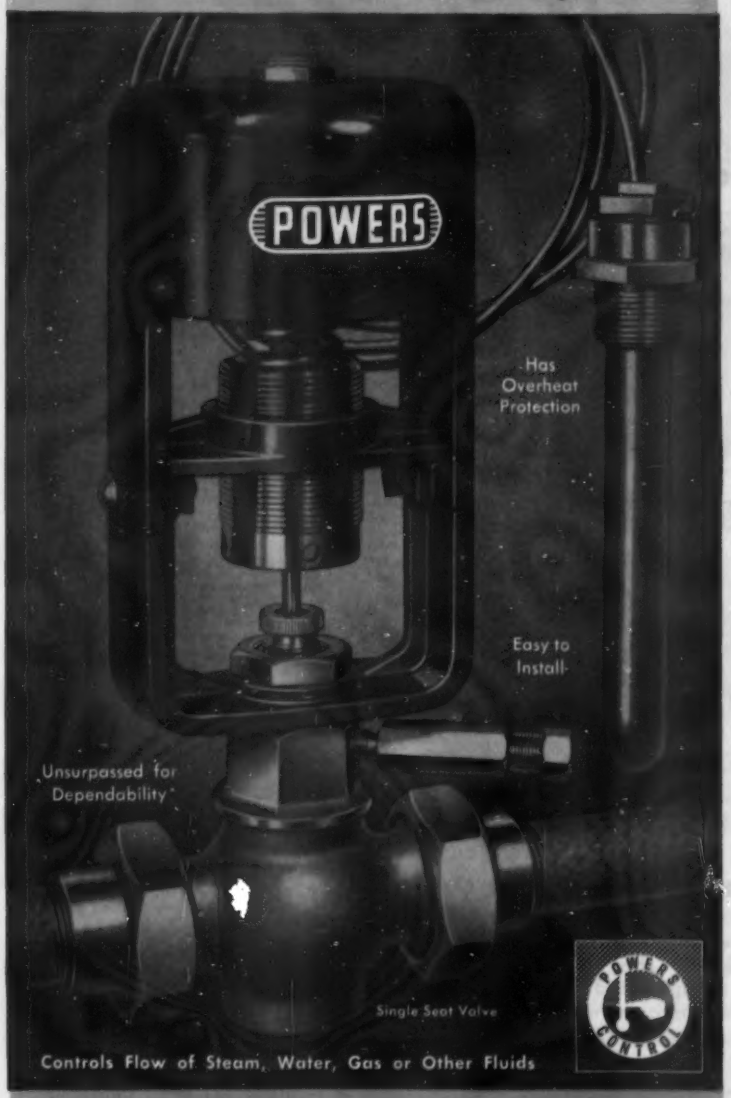
USE A MIRROR to look around corners beyond arm's length, such as underneath an engine or in the bottom of a crankcase. Take an automobile side-view mirror. Fasten a long handle of ⅜-in. copper tubing. Bend and flatten one end about 2 in. and attach to mirror, sketch. When used with a flashlight directed on mirror, you can view places you can't possibly see otherwise.

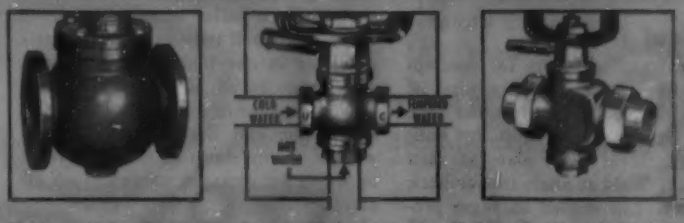
W J ARY *Seattle, Wash.*

(*Continued on page* 130)

POWERS No. 11 Self-Operating TEMPERATURE REGULATOR

Automatically holds temperature constant at the right point. Prevents losses caused by wasteful OVER-heating.



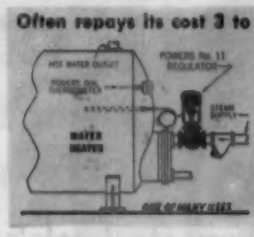


Various Valve Bodies and Inner Valves are available. Single and Double Seat Valves thru 2" have rugged bronze bodies with bronze union connections for quick, easy installation. Bulletin 329 gives information about all types.

(o88)

Why It Gives BETTER CONTROL and Saves More Money

Often repays its cost 3 to 6 times a year when used on:



- Water Heaters
- Industrial Processes
- Heat Exchangers
- Fuel and Crude Oil Heaters
- Air Compressors Diesel Engines

ONLY POWERS No. 11 REGULATOR Offers ALL These Advantages

- **Simple, sturdy construction.** Materials used are corrosion resistant.
- **Powers bellows has 50% more power** than used in the majority of regulators. The heart of a self operating regulator is its bellows. Powers with its 50% greater effective area gives better control and its durable 2 ply bellows outlasts ordinary single ply bellows.
- **Valve stem lubricator** with silicone grease aids easy movement of highly polished stainless steel valve stem and reduces drying out of packing.
- **BETTER CONTROL** results from Powers powerful bellows and minimum of valve stem friction.
- **60°F. temperature ranges** available with accuracy of ±1°F. on some processes and 2 to 3°F. on others.
- **Rugged bronze valve bodies with bronze union connections,** for single and double seat valves thru 2", reduce installation time and labor. Larger sizes have flanged iron body valves.
- **Powers Nationwide Service and 24 Hour Delivery** in the U.S.A. are important time and money saving advantages.

- **Indicating Regulator** with easy to read 4" dial thermometer helps adjust the regulator and check temperature at the bulb. Various dials and ranges are available.

Right type and size of valve is important for good control. May we help you make the right selection? Benefit from POWERS more than 60 years experience with self-operating regulators.

Call our nearest office or write us direct for Bulletin 329.

THE POWERS REGULATOR CO.

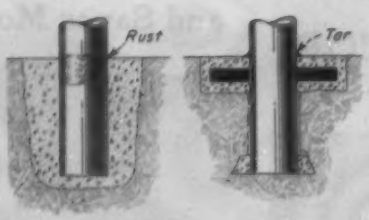
Skokie, Ill. | Offices in Chief Cities in U.S.A. Canada and Mexico | See your phone book

Automatic Temperature and Humidity Control

Established 1891

More PRACTICAL IDEAS

Begins on page 126



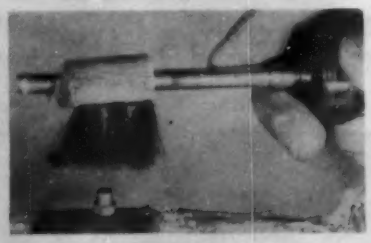
Bury steel pole's base right

FLAG POLES and other iron pipe placed in the grounds of most plants for various purposes can be a headache if you don't know how to install them.

Many engineers believe that a steel pole concreted into the ground needs no maintenance. But unless steel is painted near the concrete, moisture from dew or rain collects. So rust eats pole in concrete so badly that a wooden pole outlasts steel three to one under the same conditions.

Use heavy paint or tar to seal opening where pole enters concrete, second sketch. Then check periodically. If pole is heavy, weld cross pieces as shown and rest them in concrete to help support weight. This method pays off.

H B MCDERMID
Long Beach, Calif.

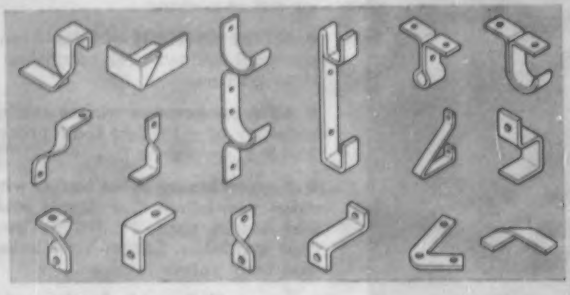


This brush cleans oil nipples

HIGH-PRESSURE grease and oil nipples keep oil and dirt out of bearings. But dirt collects on outside of nipple. Then if grease or oil gun is used, some dirt is carried into bearings. Answer is to wipe nipple clean before using oil gun. Trouble is some nipples are placed so it's impossible to get at them, although you can insert spout of oil gun, photo.

I fit a small length of wooden-backed brush to oil-gun spout, photo. Drill tight holes through brush back, force gun spout through and job is done.

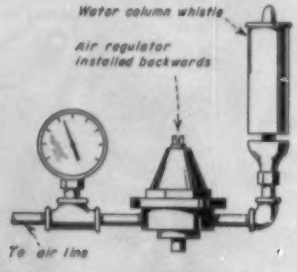
C T BOWER *London, Eng.*



Handy bends for your notebook

HAVE YOU EVER TRIED to bend a piece of hot iron-bar to shape without a pattern of what you were trying to form it to? Well, then you know the best thing to go by is a pattern of the bend made out of heavy wire. Here are some ways to form bends. These sketches may be handy to clip out and put in your notebook for future reference.

C H WILLEY *Penacook, N. H.*

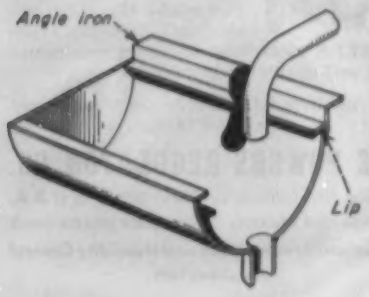


Whistle warns you of low air pressure

SKETCH SHOWS IDEA that's very useful if your plant does not have a low-air-pressure alarm. It's an inexpensive device, warns when air pressure is low. It can be connected anywhere in an air line and needs no wiring of any kind. Parts needed are (1) small reducing valve or regulator (2) small whistle of type used on boiler water-columns.

Connect small reducing valve (Watts regulator in our plant) in right pressure range to an air line *backwards*. That means valve's outlet is connected to air line and inlet is connected to whistle. Screw down on reducing valve to lowest air pressure wanted to set off alarm. Whistle continues blowing until air pressure comes back up past this setting, then pops shut.

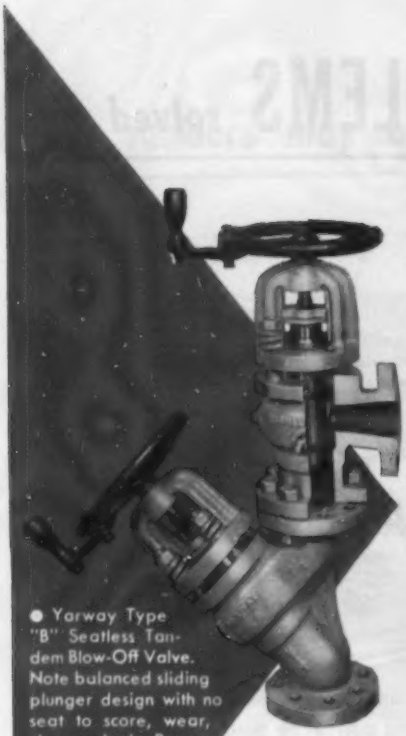
F FEDOROCSKO
New Brunswick, N. J.



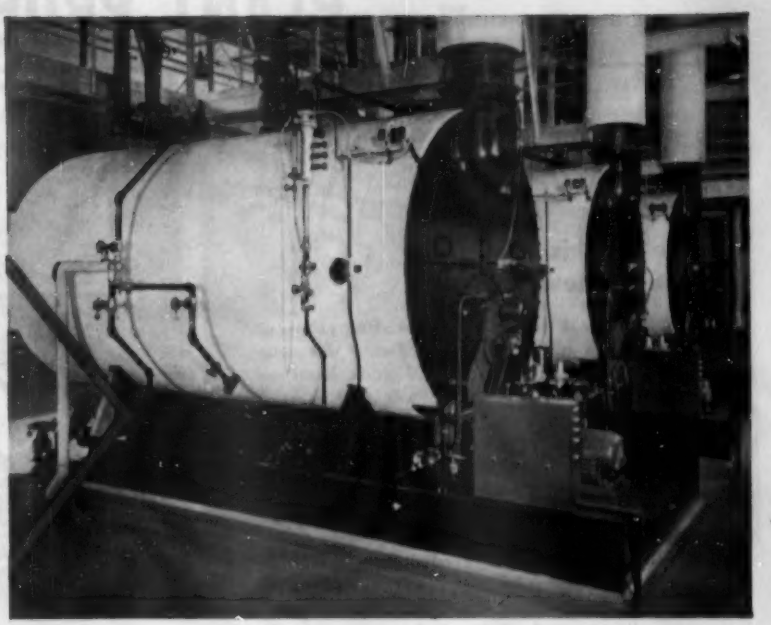
Practical troughs

YOU CAN MAKE TROUGHS for cooling-water drains easily by using pipe of whatever size you need. Just cut pipe to right length, then split in half, lengthwise. Weld light plate at each end, sketch. Weld an angle iron on back for support. Lip welded on edges prevents water splashing out. I've found that drain piping shouldn't go farther than ½ in. into a 3-in.-diameter trough.

D W ANTONACCI *Bolivar, Pa.*



● Yarway Type "B" Seatless Tandem Blow-Off Valve. Note balanced sliding plunger design with no seat to score, wear, clog or leak. Pressures to 400 psi.



selected for these Cleaver-Brooks package boilers...

YARWAY BLOW-OFF VALVES

Cleaver-Brooks package boiler installations, like the one above, include as a very important part of the picture—YARWAY Blow-Off Valves.

As many boiler makers know . . . a *good* package boiler is a *better* package boiler when equipped with dependable accessories like YARWAY Blow-Off Valves.

Boiler buyers know, too, that YARWAY Blow-Off Valves are a stamp of quality.

Whatever make of boiler you buy or use, insist on this simplified design, dependable operation, long life and low cost maintenance provided by YARWAY Seatless Blow-Off Valves. *Over 15,000 boiler plant operators know and use them.*

For more details, write for YARWAY Bulletin B-426.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

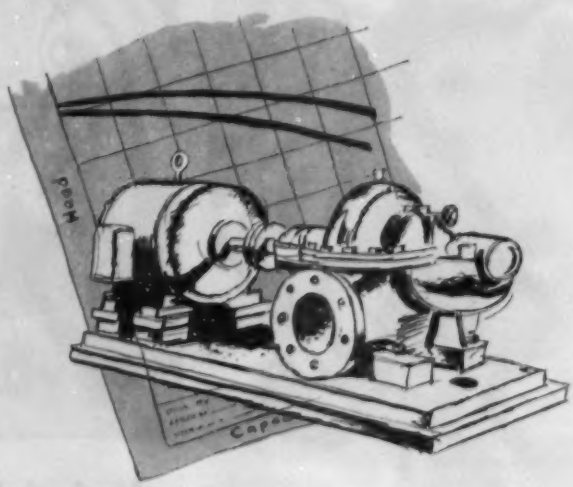
YARWAY

SEATLESS BLOW-OFF VALVES

These PLANT PROBLEMS solved by

The question

Can we use this existing pump in our new system?



THE FACTS: We'd like to use an existing pump in a new system—if it'll do the job. Pump was originally bought for a capacity of 250 gpm, handling 150-F water. Discharge pressure was 280 ft with npsh of 10 ft, resulting in a total discharge of 270 ft. Design is single stage, horizontal centrifugal. Driver is a 25-hp constant-speed induction motor running at 3550 rpm.

Full-load flow through new system is 350 gpm, handling 150-F water. But since the piping system isn't laid out yet, we think needed total discharge head can be kept down to 240 ft or less. If we go ahead with this plan, will we overload the motor? Can we modify pump? Will original characteristic curves help us out?—*SL, May Power*

The answers

Tip to SL: Note difference between npsh and static submergence

BEFORE GETTING into the problem itself, I think SL may have confused npsh with static submergence. Sketch at right shows three possible conditions on pump's suction. First case probably represent's SL's condition. 150-F water is in elevated open tank. There's 10-ft of static submergence between liquid level and pump centerline. Suction head is 10 ft, but to get npsh we must add atmospheric pressure and subtract vapor pressure at 150 F. Result is 35.3-ft npsh.

Second and third cases show suction conditions where npsh actually is 10 ft. But in second case, suction head is minus 15.3 ft, making the pump's total head about 295.3 ft.

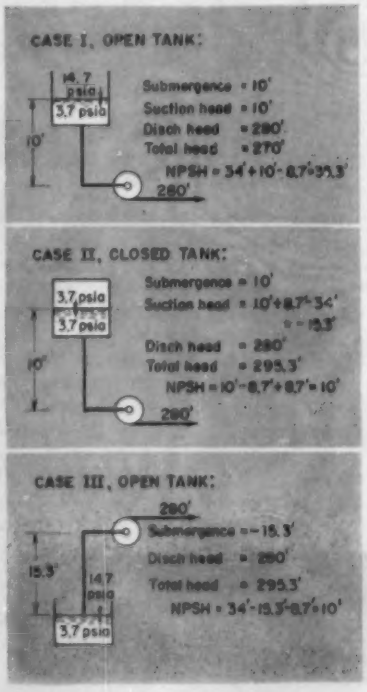
Present pump is designed for 250 gpm against 270-ft tdh when driven by a 25-hp 3550-rpm motor. If motor is loaded up, pump efficiency is about 75%—pretty close to peak efficiency. Whether or not SL can pass 350 gpm against 240-ft tdh depends on pump's characteristic curve.

It's possible that present and proposed operating points are on same curve. If so, SL needs substantially more horsepower than he has available. But if pump curve is steep, the pump may fail to make 350 gpm at any head approaching 240 ft.

Here are points SL should find out from manufacturer: (1) Can pump be modified through impeller design changes? (2) What hp driver is needed for new service conditions?

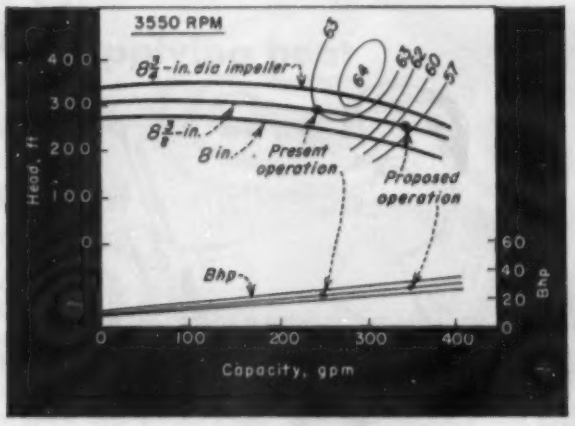
One last item: Since capacity boost is about 40%, pump's npsh needs may rise considerably. So SL should run a careful check to see if npsh available in proposed system is adequate. This point may rule out use of the pump.

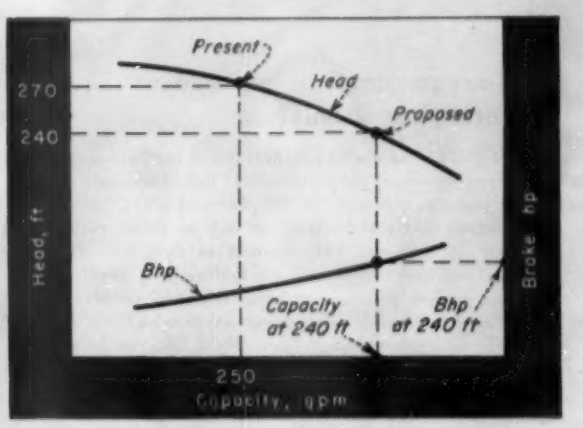
T W EDWARDS
Application Engineer
Worthington Corporation
Harrison, N. J.



our readers may be your problems too

HOWARD KALLEN, *Assistant Editor*





Check impeller size before using existing pump

BEFORE APPLYING existing pump to new operating conditions, SL should check size of impeller presently installed, and internal contour of casing. Almost all manufacturers design pumps that can be applied to many operating conditions and are efficient within a specific operating range.

Curves, similar to those above, are drawn for a particular pump design. Head-capacity relation, at constant speed, varies depending on impeller size installed in casing.

More efficient operating range for SL's pump is between 275 and 325 gpm, with heads ranging from 275 to 425-ft tdh. For this operating area, "eye" of the family of curves shows 64% efficiency. Present and proposed operating points are shown on curve for 8⅜-in. impeller, so present impeller is OK. But horsepower goes from 25 to 35 hp for new conditions. With new arrangement, pump will need a 35 or 40-hp motor.

Since final operating conditions may be altered again after piping is laid out, SL would be smart to choose the 40-hp motor for his new pumping system.

A J BREUGELMANS — *New York, N. Y.*

Get right answer with pump characteristic curves

SL SHOULD REFER to pump characteristic curves at 3550 rpm. They'll be similar to those shown above. Head-capacity curve tells whether pump can deliver 350 gpm against 240 ft. The brake horsepower-capacity curve indicates motor output needed to drive pump under these conditions.

It seems likely that the pump can't deliver 350 gpm at 3550 rpm—even at the lowered system head. And the 25-hp motor is almost certain to be too small.

Here are some steps SL can take to solve the problem: (1) Lower system head, thereby increasing delivery. Effect is shown on head-capacity curve. (2) Boost speed. Pump capacity goes up in direct proportion to speed. Head increases in proportion to square of speed. Brake horsepower climbs in proportion to cube of speed. Using these relations SL can plot pump characteristics for speeds higher than 3550 rpm and choose speed needed to deliver 350 gpm against 240 ft. (3) Modify pump.

Be sure to check with pump manufacturer before increasing speed or modifying pump.

R A LEUCHTER — *Montreal, Canada*

Here's step-by-step testing procedure for pump operating conditions

SINCE MY CALCULATIONS show that pump's motor is overloaded at new operating conditions, SL may be able to get by with lower capacity.

To run test, insert gate valve in discharge line, as near to pump as possible, with pressure gage between it and the pump. Connect an ammeter to the motor. Close gate valve and start the motor. Pressure gage will read the shutoff head. Make a record of current motor takes. Open gate valve slowly until motor draws its safe current, as marked on nameplate. Motor may be able to carry slight overload.

I figure that when motor draws 25 hp, pump conditions will be about 270 gpm at 260-ft head—about 112 psi on the gage. Proposed conditions are out of motor's range.

G GRIFFEL — *Bronx, N. Y.*

Fast figuring shows pump's motor will be overloaded

IF WE FIGURE brake horsepower needed to operate at existing conditions, assuming 70% efficiency, we get:

$$\text{bhp} = (\text{gpm} \times \text{lb/gal} \times \text{tdh}) \div (33{,}000 \times \text{efficiency})$$
$$= (250 \times 8.18 \times 270) \div (33{,}000 \times 0.70) = 23.8 \text{ bhp}$$

Using same formula for new conditions we get:

$$\text{bhp} = (350 \times 8.18 \times 240) \div (33{,}000 \times 0.70) = 30 \text{ bhp}$$

So it looks as though pump's motor will be overloaded. SL should check with manufacturer on advisability of using existing pump with bigger motor.

S R HIGGINS — *Long Beach, Calif.*

Turn page for ideas on flue-gas analysis

More PLANT PROBLEMS

Begins on page 132

The question

Will oxygen analysis improve our firing conditions?

THE FACTS: As works engineer for a medium-sized paper company, I'm responsible for purchase of power plant equipment. We're planning a new boiler installation that will burn oil as well as wood waste. Because of different CO_2 content in flue gas—for same amount of excess air—we believe CO_2 analysis not the answer to our combustion-control problem. So we're considering continuous oxygen analysis as a guide to correct excess air. We'd like to know whether readers think we're making a wise move —and why. Since we're firing mixed fuels in a 75,000-lb-per-hr boiler delivering steam at 650 psi, 750 F, should the analyzer be hooked up as a recorder or as a controller?—*WH, May Power*

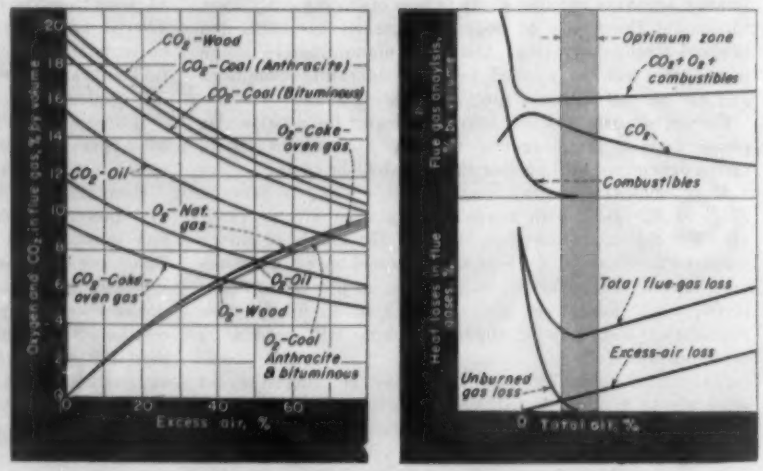
The answers

4 reasons why WH should use oxygen analysis

I FEEL THAT WH is making a wise move by using oxygen as a combustion guide for his oil and wood-waste fired boiler. And here's why: (1) Oxygen measurement is direct. It shows whether both fuel and air are being supplied in proper relation and whether they're mixing and burning properly. (2) Oxygen measurement is independent of any flow measurement. The O_2 instrument's calibration isn't affected by calibration changes of flowmetering element. This feature is especially important under low-load conditions when flowmeters tend to become inaccurate. (3) O_2 analysis is a direct measure of excess air—independent of the fuel or fuels burned. (4) Many engineers consider O_2 analysis faster, more reliable, easier to calibrate and more accurate than CO_2 equipment.

WH needs an O_2 sampling system that gives fast sampling speed to realize the above advantages.

G D FOWLE, JR
Leeds & Northrup Co
Philadelphia, Pa.



For efficient combustion: Team up oxygen and combustibles analyzers

GRAPH, above, left, shows that when CO_2 analysis is used with different fuels, same CO_2 in flue gas corresponds to widely differing excess air quantities. But measurement of O_2 in flue gas indicates about the same excess air —regardless of fuel burned.

Top part of graph, above, right, points up another disadvantage of CO_2 analysis. CO_2 content of flue gas rises to a peak at zero excess air and drops off with either increasing or decreasing excess air. So same CO_2 reading may be had from both a deficiency and an excess of air.

If limiting combustion conditions allow operation with low excess air then operation will be in the optimum zone, slightly on the excess air side, as shown by graph, above, right. It's possible to have both oxygen and combustibles in the flue gas in this zone, making it desirable to analyze for combustibles, in addition to oxygen.

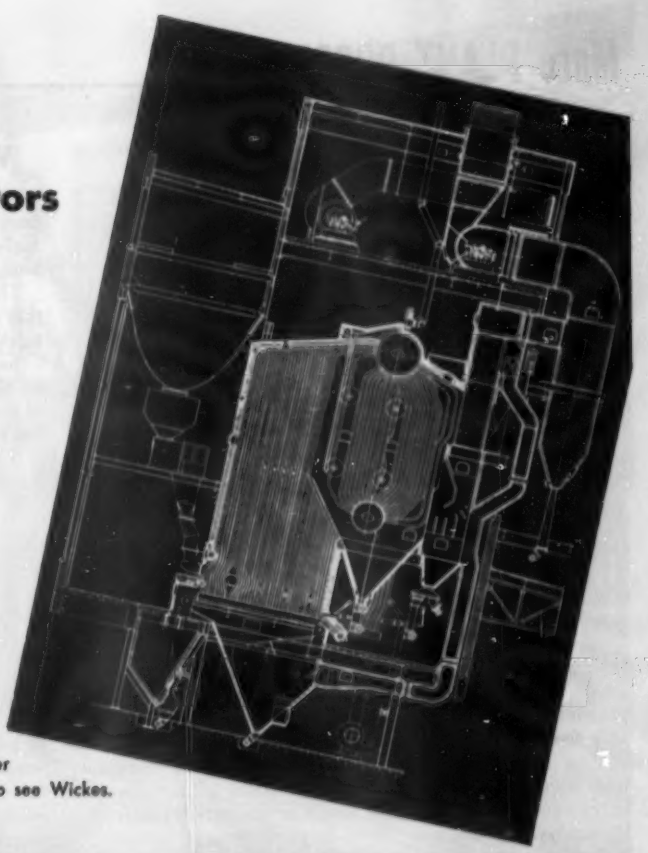
Oxygen analyzer can be used to control combustion in optimum zone. Combustibles analyzer warns of swing to air deficiency, resulting in high unburned gas loss.

R H KENNEDY *Cleveland, Ohio*

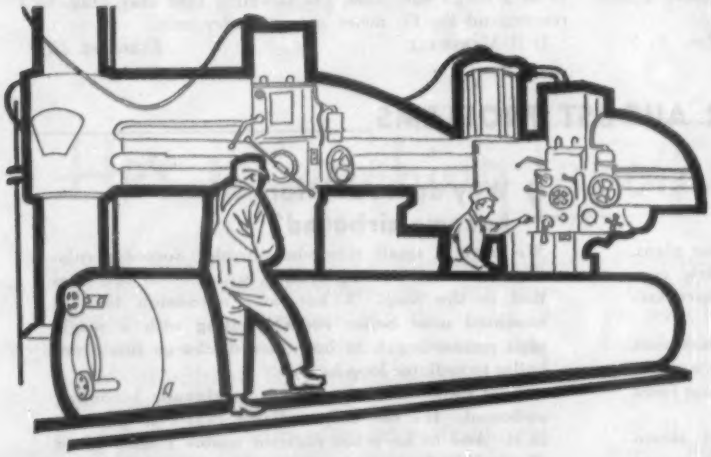
New questions, also more on oxygen analysis, p 136

WICKES

dependable steam generators for supplying heat and power in every kind of installation



Modern industry's need for heat and power doesn't come ready-made for a certain type or size of steam generator. Every installation is different. That's where the highly varied experience and extensive facilities of the Wickes Boiler Co. pay off for you in more dependable installations. Wickes engineers will design and build you a steam generator that is specifically suited to your purpose; one that will assure you of fine service for years to come, whether your installation is large or small, whether it's a schoolhouse or an atomic energy plant. Whatever the nature of your steam generator needs, it will pay you to see Wickes.



WICKES complete facilities for custom metal fabrication to exact specifications

When a company has been fabricating heavy-gauge metal assemblies for as many years as Wickes, and has built such a fine reputation for dependable products, it follows that all those skills and facilities can help you a great deal on custom fabricating jobs. We have the laboratories, the production equipment, and the inspection service to do the same excellent work for you that we do for ourselves. For exacting custom metal fabrication, write us about your requirements.

159

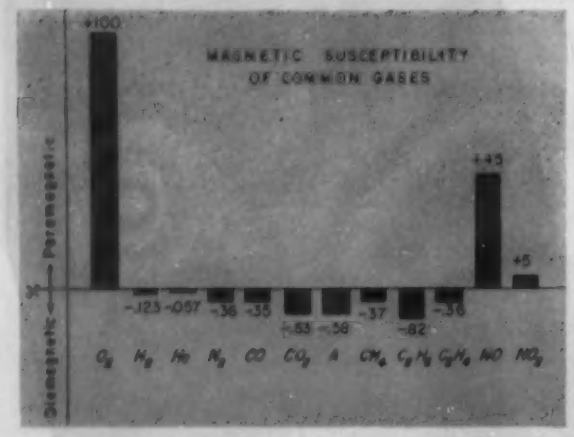
THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • **SALES OFFICES:** Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

More PLANT PROBLEMS

Begins on page 132



We save $$ with oxygen analysis

We've installed four O_2 recorders at our plant since we burn multiple fuels—blast-furnace gas, coke-oven gas and fuel oil. We've realized a 2% saving on our steam cost for four 160,000-lb-per-hr boilers.

The O_2 recorder has a time lag—perhaps too much—that's a drawback to using it as a controller. This is due to the gas analysis process within the instrument.

As checked with a heat prover, 3% to 4% O_2 is best with an oil fire. Don't forget to install test taps across the width of the boiler outlet, since gas paths vary readings from one tap to the next, can give misleading results.

B K Probert — *Rialto, Calif.*

How magnetic oxygen analyzer works

Oxygen is a paramagnetic gas—one that's readily attracted into a magnetic field. Magnetic properties of O_2 are so pronounced that it's possible to detect quantities as small as a few parts per million present in flue gas.

Most common gases are slightly diamagnetic—repelled from a magnetic field. And although oxides of nitrogen are paramagnetic, they're rarely found in industrial gases. So O_2 analysis by magnetic methods gives accurate results.

Graph above plots magnetic properties of several common gases compared to oxygen.

By installing an oxygen recorder-controller the boiler operates at maximum combustion efficiency.

H B Wayne — *Brooklyn, N. Y.*

DHM favors oxygen analyzer as recorder

CO_2 metering doesn't mean a thing when burning oil and wood waste together. If each fuel quantity is burned to yield same amount of combustion gas (one pound of oil produces 18 pounds of flue gas and one pound of wood results in 8 pounds of flue gas) at 20% excess air, CO_2 reads 14.75%. But CO_2 could be anywhere between 12.7% and 16.8%, depending on fuel proportions, and you could still have 20% excess air in combustion gas.

Problem of controlling the air with the O_2 meter and at the same time in proportion to the different fuel feeds, seems to be a tough one. Also, gas sampling tube may plug, so I recommend the O_2 meter as a recorder only.

D H Marshall — *Evanston, Ill.*

YOUR AUGUST PROBLEMS

1 What's wrong with condensate removal?

We operate a 750-kw turbine generator in our plant, with the turbine exhausting to a barometric condenser. Inlet steam is 150 psig and condenser vacuum is 27-in. Hg.

Condensate removal, from barometric condenser, is handled with a vacuum trap that includes a water spray to prevent condensate flashing due to heat from auxiliary steam entering the condenser.

Under full-load conditions and normal steam pressure the trap discharges condensate once every three minutes. Water never appears in the condenser sight glass.

But when turbine is operating at less than 300 kw or at full load with inlet steam at 110 psig or less, the vacuum trap will not operate. When this happens we have to operate the turbine noncondensing, to remove water from the condenser.

I'd appreciate the views of *Power* readers on this problem, and how it might be corrected.—*WHC*

2 Why does radiator become airbound?

We have a small single-loop-header forced-circulation hot-water heating system, with eleven radiators tied to the loop. A hot-water expansion tank is mounted near boiler room's ceiling with a single pipe connecting it to hot-water discharge line from boiler to radiator-loop header.

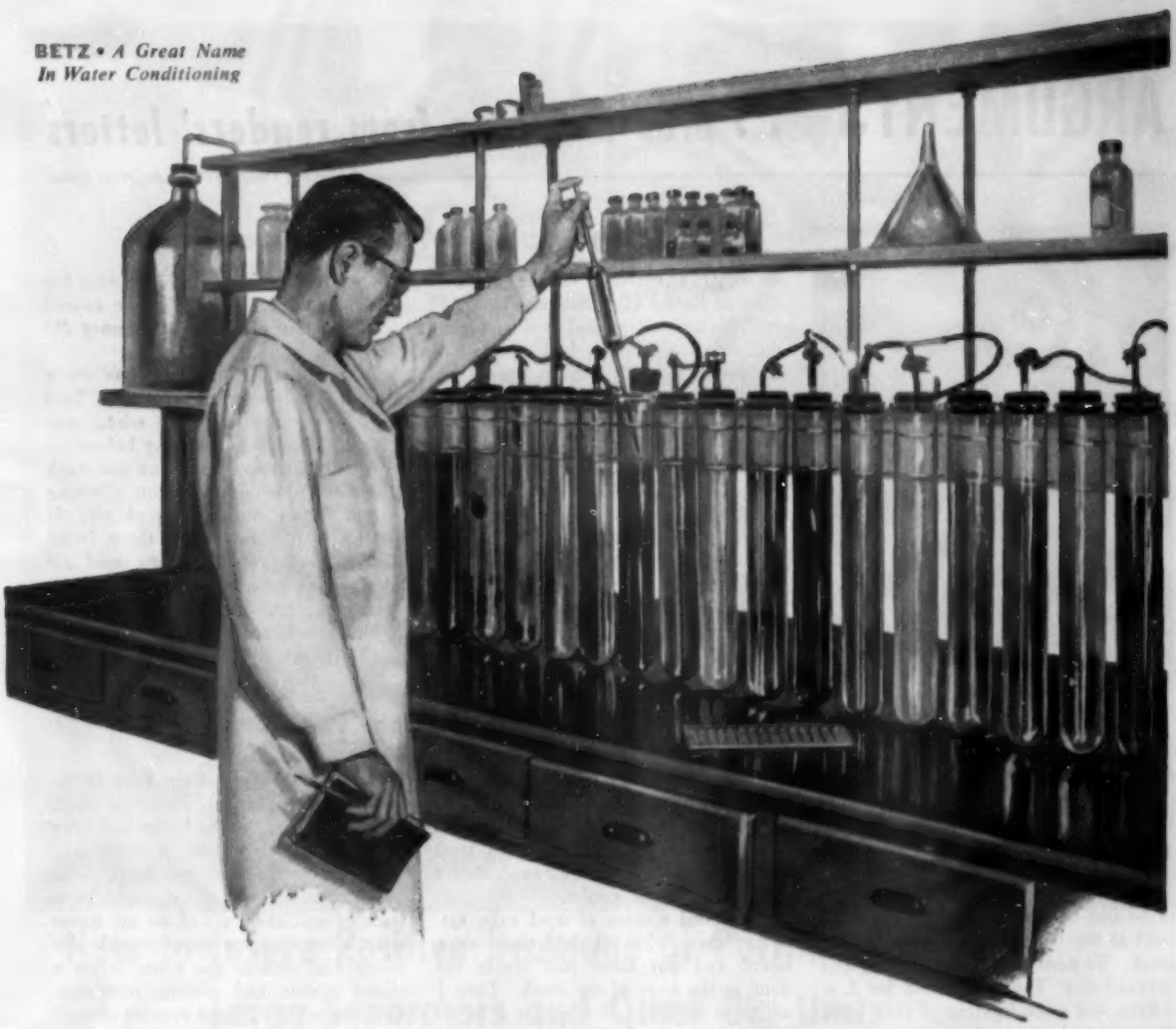
First radiator on the loop is continually becoming airbound. It's the only radiator that ever gets air in it. And to keep the radiator usable I must bleed air weekly. As a result, the expansion tank becomes flooded every year and it's a nuisance to drain and recharge it to the right level.

I've had several explanations of what's wrong but none seem to get at the root of the problem. It's been suggested that I relocate the expansion tank to the same level location, directly on the boiler. Others say this is no good.

Do *Power* readers have any ideas on how I can cure this problem?—*JAW*

Sit down right now and answer one or both of these problems. We'll pay extra for answers with photos or sketches.

BETZ • *A Great Name In Water Conditioning*



He's researching another first!

Big things are happening daily in industrial water conditioning . . . new developments . . . new discoveries . . . new techniques. As the leader in researching better ways to condition water, Betz is far out in front. The record speaks for itself. For example, Betz was

. . . *first* to develop an advanced method for the *complete* control of corrosion in condensate lines.

. . . *first* to develop an economical technique for the control of corrosion and pitting in recirculating cooling water systems.

. . . *first* to pioneer the use of effective antifoam agents for prevention of carryover.

. . . *first* to develop a practical method of silica removal from boiler feedwater.

These Betz firsts are *just a few* of the many industry-accepted water conditioning methods that have resulted from our *continuing* program of research. Many more are to follow.

Isn't this the kind of leadership and ability *you* want in water conditioning counsel for *your* plant? A Betz District Engineer will be happy to give you the details of Betz complete plant service. Talk to him today.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

ARGUMENTS . . . *pros and cons from readers' letters*

ALTHEA THORNTON, *Assistant Editor*

Boiler explosion? I say it was gas!

NEWSPAPER REPORTS of the $150,000 blast at Euclid High School on May 18 said the boiler exploded as it was being lighted. The fireman had inserted an oil-soaked "wand" into an opening in the boiler to light it as usual. He turned to climb a ladder to open a gas valve, when the blast occurred.

But signs of a gas explosion were evident. The bulged breeching was twisted like a corkscrew, with a chicken wire and asbestos garnish. (See photo.) The dampers, someone said, had been wide open.

But the fact that the explosion occurred when the fireman was opening the gas valve proves that there was a concentration of gas in the furnace top and breeching. This could be caused by stagnation of updraft. Chimney did not draw.

At this time of the year one water tube boiler is operating. It must have been shut down after the school was closed around 5 pm the day before.

Heat of furnace, breeching and stack dissipated during the night, allowing damp air to replace heated air. It reached the point where there is no draft. Weight of the damp, cold air in the stack prevented any possible gas from escaping.

When the fireman inserted the lighted

(*Continued on page* 192)

Tall stack + fan = no draft? Two readers say 'yes', one 'no'

Marmy's yarn in May POWER reminds me of the procedure followed at the U.S. Steel Co plant in Duluth, Minn., after overhauling an open-hearth furnace and waste-heat boiler.

Several days before the furnace was to be put on the line a fire would be built in the base of the 200-ft concrete stack. We used old lumber, crating and railroad ties. The fire burned for 2 or 3 days, and when lighting-off time came there was plenty of draft.

The coal-fired boiler room was arranged two boilers per stack. The same procedure was followed there if the stack was cold because both boilers had been off the line at the same time.

L M LARSON *Milwaukee, Wis.*

We have had the experience Marmaduke tells about in the May issue. Two natural draft boilers were going on the line in zero weather. We had a steel stack that had just been cleaned. Boiler room was full of smoke.

I grabbed a mass of used rags, saturated them with oil, laid them on a board and put them just inside the door at the base of the stack. Then I set them on fire, and soon got a favorable balance in the stack because the blaze sent a rush of hot air upward.

W S CLARK *Marseilles, Ill.*

I can't follow Marmaduke's reasoning about the fan being unable to start draft through the boiler.

Being a fluid, air at the base of the stack presses in all directions with equal pressure. As the boiler had been shut down for a month, it would naturally be at the same temperature as the outside air. So there would be a state of equilibrium and no air movement when dampers were opened. Air inside and outside the stack forms a closed circuit, and starting movement up the stack would not require enough energy to lift the entire column of air (13.2 lb per sq ft, Marmaduke says).

A difference in barometric pressure between bottom and top would start a flow. Either of two factors would accomplish this: (1) warm air that would

(*Continued on page* 192)

Basis for Data Sheet challenged

Author DePaoli of the April Data Sheet missed a bet. He presents values for economical high-temperature pipe insulation, but gives only the temperature of the steam. He presents no value for the pressure.

Heat transfer by conduction and radiation vary with the temperature only, but transfer by convection varies with several additional factors. These include the following: (1) steam density (2) velocity (3) viscosity (4) surface roughness of inside of pipe wall (5) horizontal or vertical attitude of the pipe.

The first three factors determine the film coefficient on the inside wall. Without this information, you can't calculate the heat transfer rate and prove one insulating size cheaper than another. The last two factors are not functions of the steam, so they may be fixed.

RICHARD SCROXTON *Akron, Ohio*

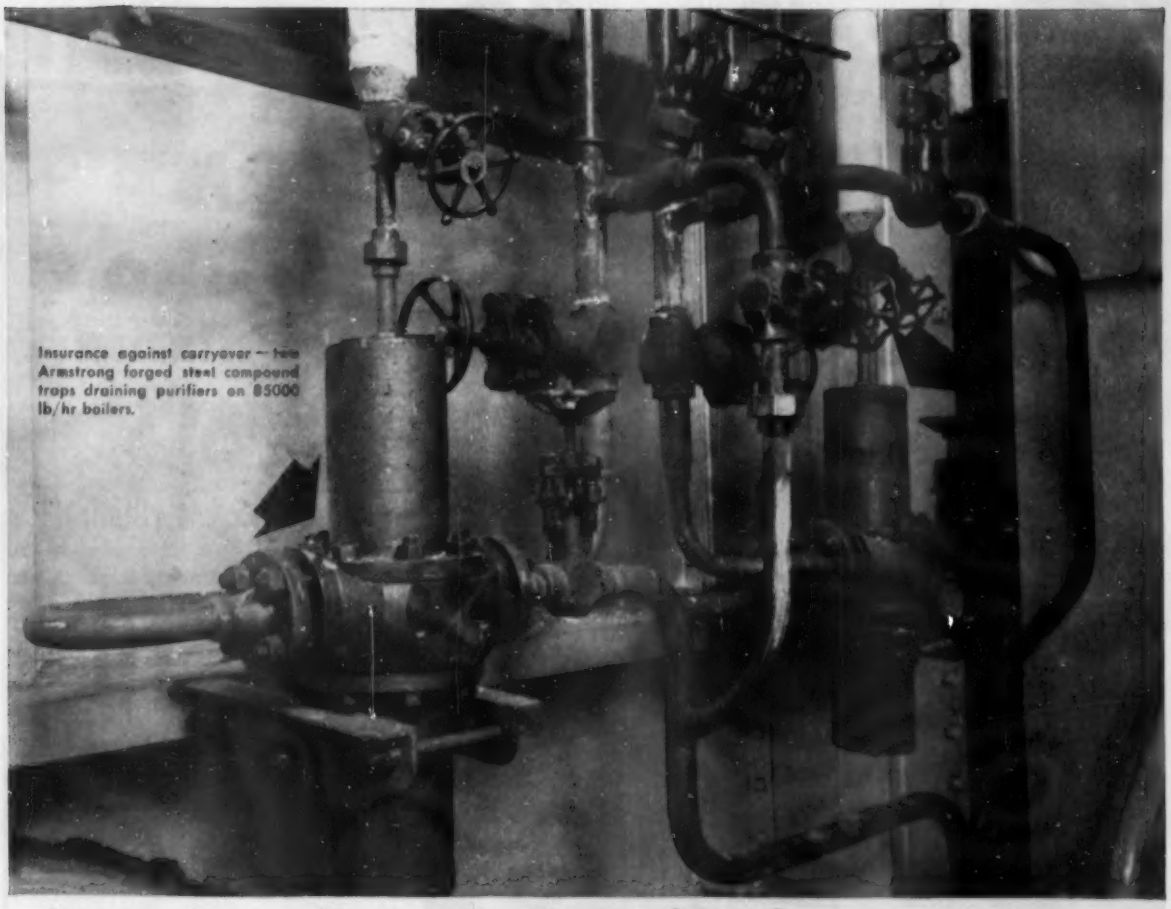
Author defends his calculations

The basic principle of insulation is to retard heat transfer from a hot body to a cold body, or vice-versa. Diatomaceous earth and 85% magnesia do this by trapping thousands of tiny air spaces within a non-combustible material.

If the insulation meets manufacturing standards, each air space is sealed off from those surrounding it, thus preventing any air flow within the material. Also, if it is applied right, air cannot flow along the interface of insulation and pipe's outer surface. So you get no convection until heat transmitted reaches the ambient air.

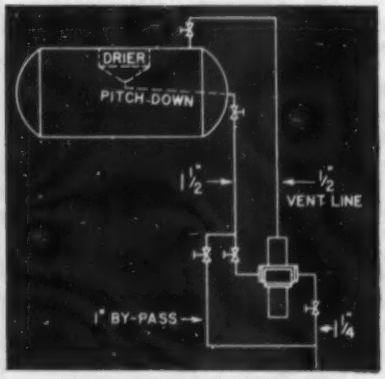
My calculations assumed that (1) pipe outer surface was at same temperature as the fluid flowing (2) heat transfer through insulation was mainly caused by conductance (3) convection and radiation occurred only in transferring heat from outer surface of the insulation to the surrounding air.

HENRY DEPAOLI *W Reading, Pa.*



Insurance against carryover — two Armstrong forged steel compound traps draining purifiers on 85000 lb/hr boilers.

How to Insure Positive Drainage of Purifiers, Large Separators and Other Big Units . . .



Automatic, dependable drainage of steam drier in industrial power plant with Armstrong compound steam trap.

● When you run up against a carryover or condensate load too large for ordinary traps to handle safely, Armstrong Compound Steam Traps are an ideal answer. They provide automatic, dependable drainage of loads up to 240,000 lbs/hr at 600 lbs. pressure. They have been thoroughly proved in service on purifiers, separators, driers, storage type hot water heaters, evaporators, vacuum pans and other large units.

Exceptionally high capacity in a relatively small trap is accomplished by a large piston-operated discharge valve controlled by a standard Armstrong inverted bucket trap mechanism. Cast semi-steel and forged steel models are available with 1", 2" and 3" pipe connections. Size, price, simplicity of mechanism, quality of materials and ease of installation are all in their favor.

ASK FOR BULLETIN 215

. . . contains complete physical data, prices and installation notes. Call your local Armstrong Representative or write: Armstrong Machine Works, 812 Maple St., Three Rivers, Michigan

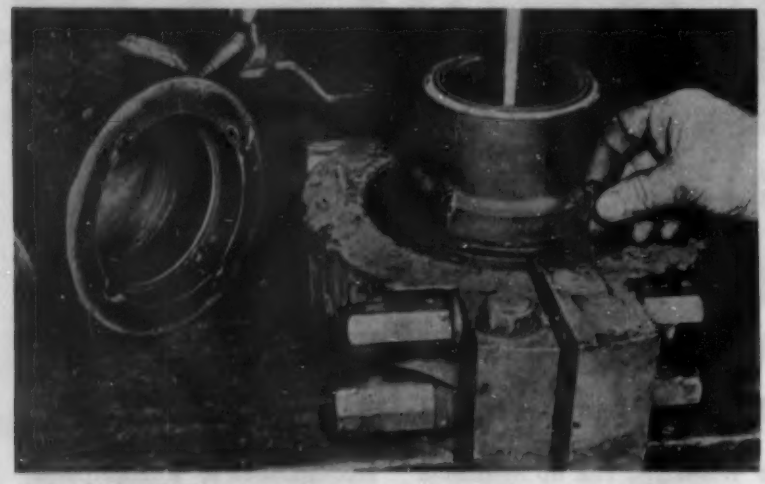
STEAM TRAPS FOR EVERY REQUIREMENT

ARMSTRONG

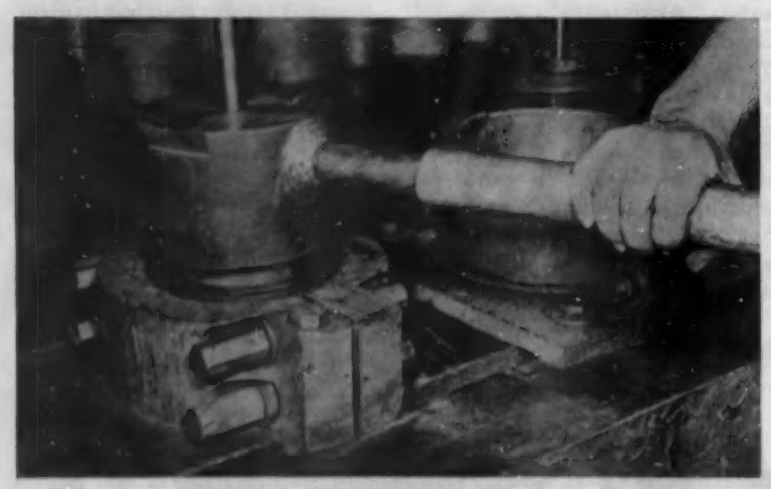
APPLICATION ENGINEERED

STEAM TRAPS

SPECIAL WRENCH, *at left,* is made to fit over valve cap while disk is held in special vise. Here, valve cap is on stem with disk removed at tip of the valve stem



KEYS ARE INSERTED in little slots cut in valve cap after disk is clamped in vise. This bracket-type vise can be made to fit any size of valve that is hard to hold



WRENCH is now placed over valve cap, locked to the cap with four keys. This wrench does not crush valve cap and vise holds disk firmly without distortion

HOW TO

disassemble control valves

► REMOVING A DISK from cap of a high-pressure steam-turbine control valve is a problem. Usually high temperatures cause valve parts to adhere so tight that trying to remove them causes damage. San Francisco Naval Shipyard solved this problem with a special wrench and holding device.

Now, valve assembly is placed in the holding device shown, keys inserted on cap and the wrench placed over cap. Force is applied on end of wrench and valve unscrewed.

Shop-made tools shown can also be used for removing disk nuts, disk and stem assemblies of stop and throttle valves. It will pay you to make these devices for valves of other designs if you have similar trouble.

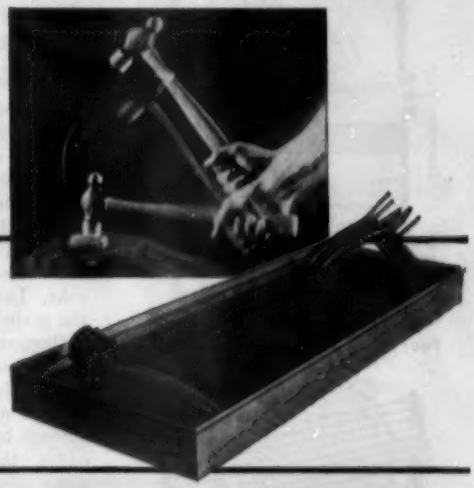
Courtesy, *Buships Journal*

NEW Silco-Flex MOTOR INSULATION

Offers These Amazing Physical Properties

Allis-Chalmers, working with Dow Corning Corporation, has developed *Silco-Flex* motor and generator insulation . . . truly new in concept . . . truly new in effectiveness.

Silco-Flex insulation employs a pure silicone rubber combined with specially developed application techniques to produce an insulation unmatched by any other in use today.



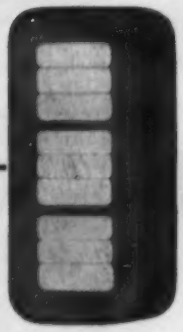
● **Flexibility and Resilience** — *Silco-Flex* insulation remains flexible and resilient indefinitely. It is especially resistant to mechanical abuse and to stresses of overloading, rapid starting and stopping.

● **Moisture Resistance** — Completely sealed, *Silco-Flex* insulated coils are the most moisture-resistant commercial coils ever produced. They are production-tested while submerged in water . . . by far the most complete and searching high potential test used.

● **Abrasion Resistance** — Samples of insulation at right show effects after sandblasting with 90 grit aluminum oxide and 100 psi air for one minute. Nozzle-to-sample distance was six inches, thickness equivalent to 2300-volt insulation. Note difference in abrasion!

Silco-Flex Insulation | Polyester Mica Tape | Asphaltum Mica Tape

● **Homogeneity** — *Silco-Flex* insulation is a void-free dielectric barrier vulcanized into a unified insulating wall. It maintains its homogeneity under extremes of differential expansion and contraction due to thermal cycling.



Other Advantages include exceptionally good thermal stability and chemical inertness. *Silco-Flex* insulation is also a much better heat conductor than ordinary electrical insulating materials. Moreover, enclosures now required to protect windings from moisture and abrasion may be eliminated in many cases.

New *Silco-Flex* insulation is immediately available for all Class H form-wound coils and for Class A and B windings operating under selected service conditions. For complete information, call your Allis-Chalmers representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4774

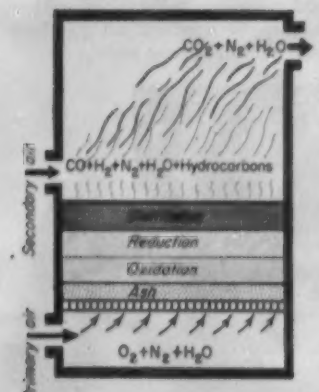
Silco-Flex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

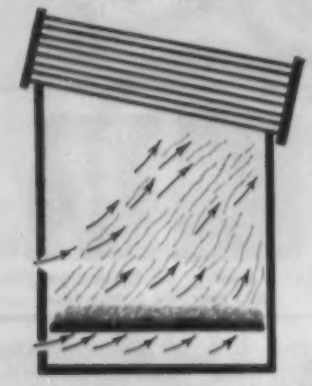
BASICS . . . *bringing engineering theory down to earth*

TOD WALDRON, *Assistant Editor*

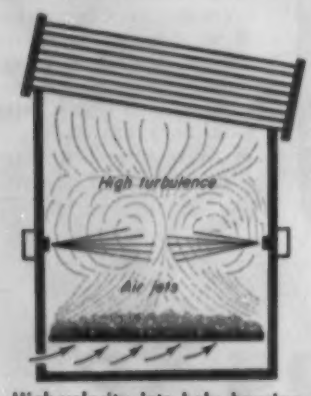
How fuels burn-8



Four zones for fuel-bed firing



Poor mixing gives poor burning



High-velocity jets help burning

► FUEL-BED FIRING can be divided, for easy visualization, into four more or less uniform layers extending across the grate—first illustration. In the top layer, green coal receives furnace heat, volatile matter distills off, and the coke thus formed works down through the bed as lower layers burn out and new coal is added.

In the oxidation zone, coke is burned to carbon dioxide with the primary air rising through the bed. This carbon dioxide travels up through the zone above, where it is partly reduced to carbon monoxide by contact with hot coke. Layer of ash at bottom protects the grate from excessive heat.

Oxygen in the primary air is pretty much used up a few inches above the grate, this being the oxidation zone. If it were not for air that rises rapidly through blowholes and leaks around the edges, there would be little oxygen above this point except that brought in by secondary air. Increasing the amount and velocity of primary air speeds up burning—but this does not alter the fact that oxygen is largely consumed a short way above the grate.

Only a little carbon monoxide is formed until all oxygen is gone. But rate of CO formation becomes rapid as soon as this point is reached—in other words, at the beginning of the reduction zone. As distance from grate increases, CO continues to form, but at a slower rate. So the thicker the fuel bed, the greater the amount of CO formed. Because reduction of CO_2 to CO depends on time of contact between gas and coke, higher air velocities mean less CO.

Fuel-bed temperature depends largely on firing rate being higher at high rates. Usually temperature within the bed is greater than at the surface. If this temperature is above that at which ash fuses, clinker may form.

Overfire burning. About half the burning job must be done in the space above the fuel bed. Its success determines to a large extent the efficiency of the entire operation. The job is complicated by the fact that composition of the combustible gas above the fuel bed varies from point to point. And uniform distribution of air is hard to obtain.

Stratification is likely to occur. In other words, separate streams of gas and air will leave the furnace without mixing. As in all forms of firing, excess air, above the theoretical amount needed for complete combustion, is supplied. This increases chances for air and gas to meet and mix.

Furnace size. Size of combustion space is highly important. Generally speaking, the less excess air, the larger must be the space. And, of course, more space is needed for higher burning rates. For any given set of conditions, size of combustion chamber plays a big part in assuring completeness of combustion. Mixing is perhaps the most important of the "given conditions."

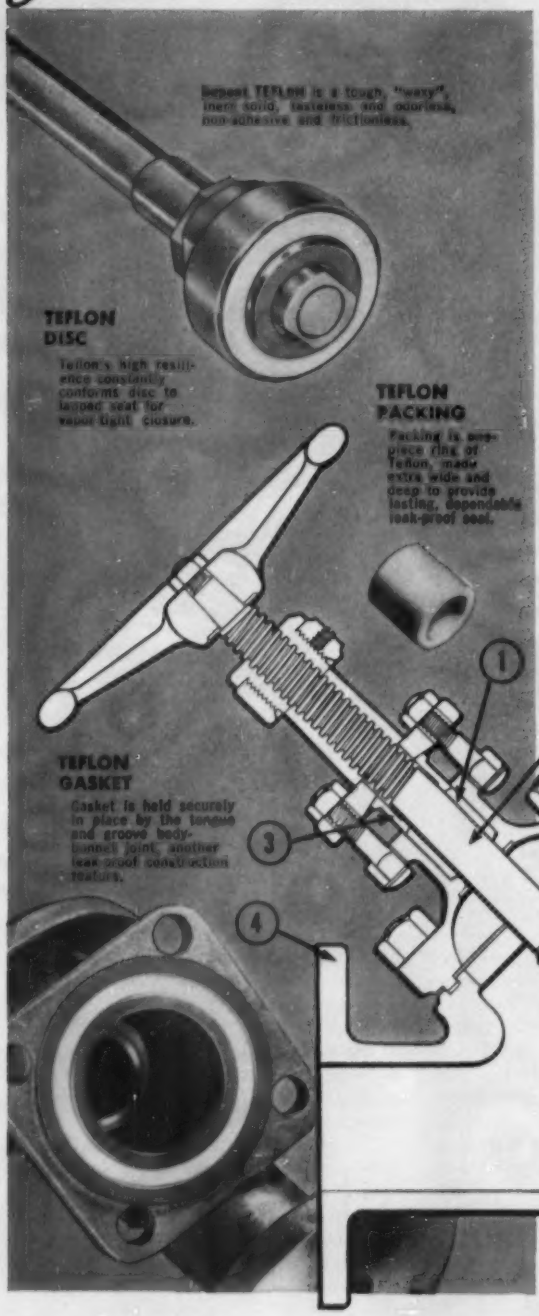
With poor mixing, combustion is likely to be incomplete no matter how large the space (see middle illustration). With good mixing, combustion may be completed quickly and added space would be of no value. Incomplete combustion means heat loss in form of unburned CO and carbon. Likewise, high excess air means loss of sensible heat in flue gas.

Turbulence. Furnace design that makes maximum use of space is the best all-round balance of these factors. Here, as before, turbulence proves the vital factor. Modern practice leans strongly to such devices as high-velocity jets to obtain good penetration, high turbulence and thorough mixing (see bottom illustration). So, in effect, the furnace size is increased without actually enlarging its dimensions.

In an existing furnace that burns a given coal, there is a certain percentage of excess air that gives most economical operation. For a boiler having a high-stack temperature, best excess-air percentage is lower than for a boiler with low-stack temperature. For most furnaces, best results follow setting excess air to give a trace of CO in flue gas.

This is the last article in this series. Next month, as mentioned in the July issue, we start the "Fluid Flow" series, written by Howard Kallen.

Jenkins designed for trouble-free performance . . . a


Inpast TEFLON is a tough, "waxy", inert solid, tasteless and odorless, non-adhesive and frictionless.
TEFLON DISC
Teflon's high resilience constantly conforms disc to lapped seat for vapor-tight closure.
TEFLON PACKING
Packing is one-piece ring of Teflon, made extra wide and deep to provide lasting, dependable leak-proof seal.
TEFLON GASKET
Gasket is held securely in place by the tongue and groove body-bonnet joint, another leak-proof construction feature.
1
2
3
4

STAINLESS STEEL "Y"

to lower costs in a wider range of

CORROSIVE SERVICES

For food and chemcial plants, and similar services, Jenkins Fig. 1335 "Y" Globe offers many advanced features that will lower operating costs and keep your processing lines trouble-free. The disc, packing, and gasket are tough, resilient Teflon. Tasteless and odorless, it eliminates problems of contamination.

The "Y" pattern permits full flow, nearly equal to that of a gate valve, and also provides the vapor-tight closure and the ease of disc renewal of a globe valve.

Fig. 1335 offers extra value by any test . . . *initial cost, operating efficiency, low maintenance.* You can convert this extra value into *extra savings* on your toughest corrosive services. Call your Jenkins Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.

FULL, FREE FLOW through Fig. 1335 is nearly equal to flow through a gate valve.

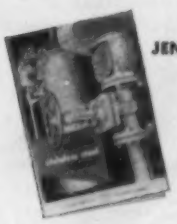
Fig. 1335 "Y" GLOBE
150 lbs. O.W.G. at 500°F
230 lbs. O.W.G. at 100°F
Sizes 1" to 4"

(1) **Packing Box**—Exceptionally deep and wide to hold optimum size packing.

(2) **Spindle**—Polished shank, long-operating threads, bevel shoulder for backseating.

(3) **Gland**—Two-piece for equalized pressure, tight seal.

(4) **Flanges**—Conform to M.S.S. Standard Practice S.P.42 Specifications.



JENKINS STAINLESS STEEL VALVE BOOKLET illustrates and describes wide range of Jenkins Globe, Gate, Check, and Y Valves, includes selection data, survey forms. Ask for Form 200-A.

JENKINS VALVES

"One morning a week later I awoke on a siding next to an oil refinery."

Mystery of the noisy blowers

► CONSULTING ENGINEER Marmaduke Surfaceblow may come up with some unusual yarns, but everyone must admit each one packs a lot of engineering information. Letters come in from college professors, firemen, consulting engineers and even from engineers' wives. His methods may be unorthodox, but he has one quality that all our readers admire—he gets results.

When POWER subscriber Gordon Lewis, from Vancouver, B.C., dropped into our office, we hiked over to call on the old consulting engineer. Marmy was busy in his dingy office above O'Houlihan's Machine Shop & Engine Works. As usual, he was sketching on a sheet of paper and puffing away on a cigar butt.

"What do you think will happen to firemen when our plants use atomic fuel?" I asked meekly, trying not to rub the weather-beaten sea dog's fur the wrong way.

"Bilgewater on firemen, on reactors and on editors," bellowed Marmy, throwing down his pencil and giving the two of us the once-over. "I'll tell you guys about the time I took four noisy blowers and quieted them down so you couldn't hear them run."

With that blast out of his system, Marmy settled back in his swivel chair while Gordon and I grabbed a seat. "Back in 1934, I steamed into Boston with a cargo of bananas from LaSeiba, British Honduras," roared Marmy in his foghorn voice. "Banana prices were on the skids so the line hired our ship out on charter. That would earn more than hauling bananas.

"The top brass got a foggy brain storm and came up with a publicity stunt. Idea was to build good will by giving away the entire cargo of bananas. They gave a press party for local reporters. That evening Boston papers carried front-page stories saying each reader would be given a bunch of bananas next day. That turned out to be the most exciting local news since Paul Revere's midnight ride.

"Next morning thousands of people mobbed the dock. They came with cars, wagons, pushcarts, boxes, sacks and suitcases. They tied up traffic for blocks along the waterfront. That mob rushed the ship like a horde of African army ants, pushing everything before them. In no time they had complete control of our ship and dock. Everyone seemed to be lugging bananas. Before long the dock and streets for blocks around were strewn with squashed bananas.

"It got so bad that people, shoving through the crowd against those coming from the ship with bananas, would slip, slide or fall. Some were trampled into the slushy bananas. A stampeding herd of buffaloes was orderly compared to those yelling, shoving humans. That shows the more you give people for nothing, the less they appreciate it.

"By evening, when that nightmare was finally over, half the bananas were trampled into the street. And to make it worse, the shipping line had to pay the city for cleaning up. Then at the last minute, the line lost the charter, so they ordered our ship into boneyard.

"After securing the engine room, dumping the boilers, draining all the lines and blowing them out with air,

(*Continued on page* 192)

West Penn Power Company selected Gulfcrest Oil to lubricate this 140,000 kilowatt unit on the basis of its outstanding performance in the other turbines at their Springdale, Pennsylvania Plant.

—they looked at the record and again selected

GULFCREST OIL

When the West Penn Power Company looked at the record of Gulfcrest Oil in its seven turbine units at Springdale, the choice of lubricant for Number Eight was no problem—Gulfcrest again!

Here's what the record showed: In each of the seven units the original fill of Gulfcrest had been in service for years without any significant changes in its characteristics. And of course the turbines operated continuously and dependably during this period.

A record like this did not just happen. It is the result of careful selection of crude oils that are thoroughly refined, then super-refined by Gulf's exclusive Alchlor Process, which removes the unstable hydrocarbons that remain after normal refining. This discarded portion, if allowed to remain in a turbine oil, accelerates oxidation, increases neutralization number, forms sludge, and harmful acids.

So to insure safe, long-lasting protection for your turbines, specify Gulfcrest—the world's finest turbine oil. Contact your nearest Gulf office today and have a Gulf Sales Engineer recommend the proper grade.

GULF

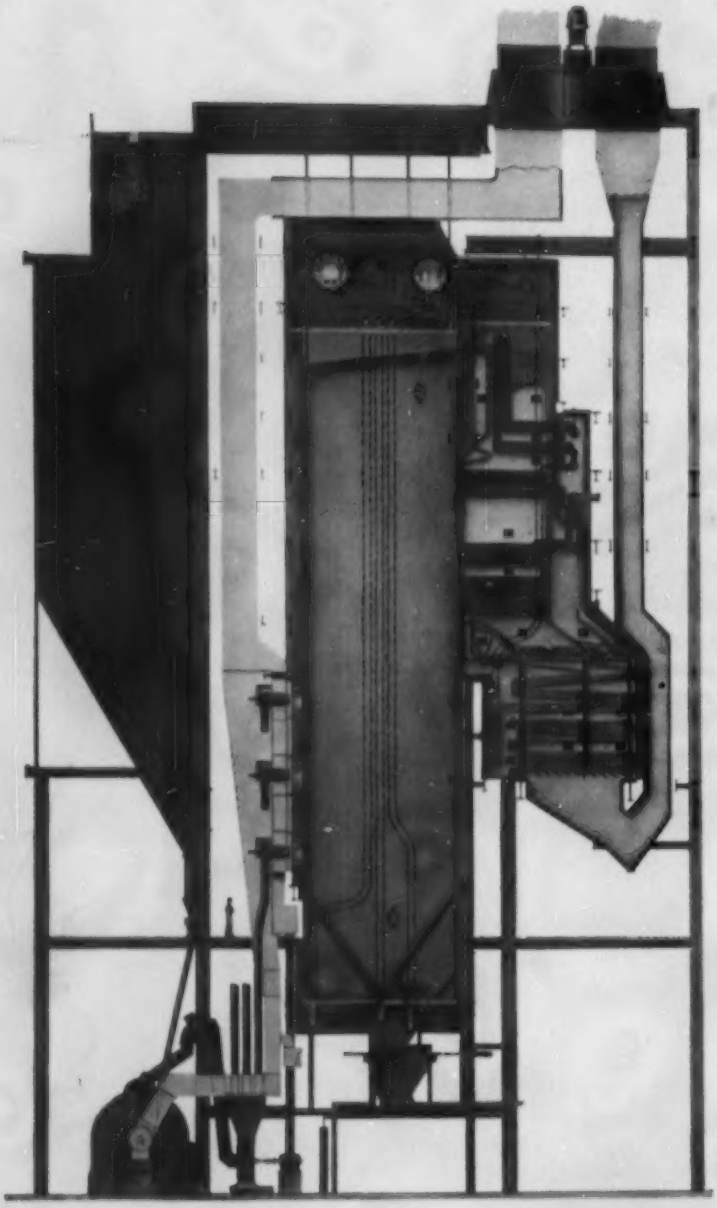
THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

GULF OIL CORPORATION • GULF REFINING COMPANY

1822 GULF BUILDING, PITTSBURGH 30, PA.

Now "on the line"— another

"FIRST" and "LARGEST"



World's first dual-circulation REHEAT unit and New York City's largest steam generator —designed and built by Foster Wheeler— serves new 180,000-kw generator at East River Station

Cross section of Foster Wheeler Dual Circulation Reheat Unit for the East River Station of the Consolidated Edison Company of New York, Inc.

To keep *ahead* of rapid load growth in the world's largest city, Consolidated Edison Company of New York has constantly anticipated the electric and steam needs of its customers.

Latest step in a long-range expansion program is the completion of Unit 7 at the East River Station. This new 180,000-kw generator is served by a Foster Wheeler 1,450,000 lb/hr dual-circulation reheat steam generator operating at 1850 psig, 1000 F/1000F and arranged for pulverized coal firing. It is the first combination unit of this type ever built and the largest steam generator in New York City.

Through the application of the Foster Wheeler dual-circulation principle it is expected that steam of extremely high purity will be produced, particularly with respect to vaporized silica. The radiant superheater, in combination with a convection superheater, enables full primary steam temperature to be attained at from 35% to 100% of rated load. The reheater, located in the low-temperature zone after the convection superheater, provides protection against all variables in operation. This combined dual-circulation reheat unit is conservatively rated, with low heat-absorption rates per unit area and low furnace exit gas temperatures. FW turbulent burners and FW ball mills further contribute to high fuel economy per pound of steam generated.

For further details on Foster Wheeler dual-circulation steam generators, send for your copy of Bulletin B-50-11.

FOSTER WHEELER

Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

Reader service section

Start with these quick samples . . .

'Waterless' hydro plant . . .

will use crude oil plummeting nearly three miles down the Andes to spin its turbines. That's the idea put forward by John Williams, president of Tulsa's Williams Brothers, for a pipeline they're building in Bolivia. It drops 15,000 ft in one 48-mile stretch into Arica, Chile. Instead of pressure-reducing stations along the line, Williams' Yankee ingenuity suggests turbines to extract useful energy from the available head. For more dope on these 'petroelectric' turbines, as well as other new ideas, keep an eye on future Reports from the Field.

Million-dollar test center . . .

handles rotating electrical equipment to 70,000 kva. Largest known facility of its kind, this GE center serves as a testing ground for equipment that previously had to be checked after installation. Reports from the Field has the story, plus other news from the power world . . . . p 150

Good way to save a 'buck' . . .

is to check over-all economy in central station design. Technical Briefs abstracts a hard-hitting paper on this timely subject, gives you info on where to send for the complete report. And there are 11 other fast-reading digests on fuels and firing, electrical machinery, engineering materials, steam turbines, to keep you posted . . . . . p 152

Troubled with gas?

You'll be interested in Allis-Chalmers' new 3000-hp motor for hazardous gas-contaminated areas. Its enclosure uses inert gas to keep out the explosive kind. Just one of the problem-solving developments reported for you in Plant Equipment News . . . . . p 156

Vacation packing . . .

is uppermost in most minds now, but if you're more concerned with the leak-stopping kind, take a look at Items 23 and 24 among the half-hundred useful brochures listed in this month's Free Literature . . . . . p 165

Do you deliver the goods?

Or are you 'tied down' like the jersey cow George Edwards tells about? To see how he equates humans and cows, turn to his Scrapbook . . p 168

For other timely ideas, see following service pages ▶

New Sarco Thermodynamic Steam Trap practically eliminates maintenance!

Only moving part—a hardened Solid Stainless Steel Disc—practically wear-proof!

SOME OF MANY ADVANTAGES

1. Same trap for all loads and pressures 10-600 psi.

2. Closes tight on no load.

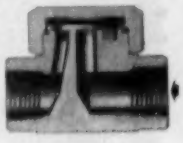
3. Operates against back pressures up to 50% of inlet pressure.

4. Not affected by superheat, water-hammer, vibration, corrosive condensate.

5. Smallest inventory of spare parts.

SIMPLICITY—to the Nth degree!

No valve-closing mechanisms to wear or stick. No critical clearances to choke. No gaskets to leak. Three simple parts...machined from stainless steel bar stock. Only one moving part.
What could be simpler?



SARCO COMPANY, INC.

5133-B

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

Please send me: ☐ Bulletin 255-44
☐ A Sarco Thermodynamic Steam Trap for 60-day trial. Size_____ for installation on_____

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 226

New center can test 70,000 kva rotating equipment

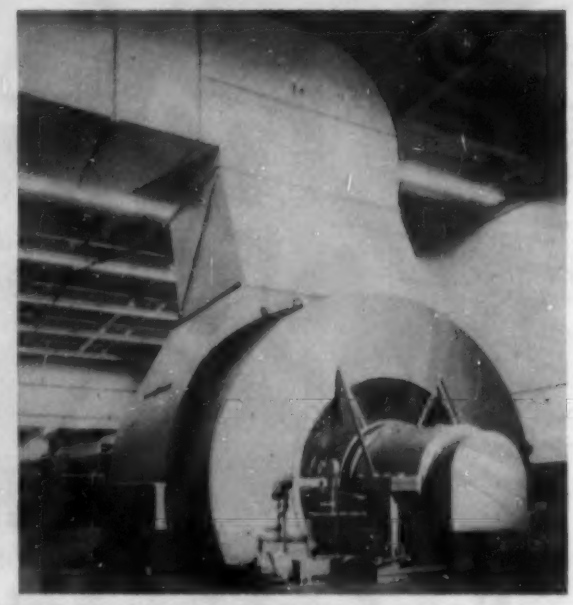
► ENGINEERS at General Electric Co's Schenectady plant can now make factory tests on larger rotating electrical equipment than ever before.

Equipment up to 70,000 kva can be tested in a new million-dollar test center that was formally dedicated June 21. It is part of an $8-million expansion program in GE's large motor and generator department.

Machinery that can now be factory tested includes: synchronous condensers up to 70,000 kva; large hydro-generators; dc motors and generators. Ac synchronous and induction motors and generators can be tested by the zero-power factor method, under conditions more severe than are encountered in the field. All this equipment previously had to be tested after installation in the customer's plant.

The test center occupies an area of 4188 sq ft, and the instrument stands on the factory floor proper occupy about 1425 sq ft. The large rotating machines to be tested are erected in the assembly area and run by power lines from the test room. It is the largest known facility of its kind in industry today.

Heart of the test room is a synchronous generator with a base rating of 60,000 kva (photo) driven by a variable-speed dc motor to provide test current of variable frequency. A motor-generator set to supply the dc current, exciter sets,



and elaborate switchgear are also in the test room which has its own filtered air supply.

Test current at zero power factor lagging—with voltage and current 90 degrees out of phase—can be supplied to the largest rotating equipment GE makes.

Little big inch system to carry petroleum again

► TEXAS EASTERN Transmission Corp received Federal Power Commission approval to remove the major portion of the little big inch system from natural gas service. Substitute facilities to be constructed will maintain the company's gas delivery capacity.

George T Naff, president, says the decision and the related order and certificate by the Federal Power Commission permits Texas Eastern to reconvert some 1168 miles of the little big inch line to transporting petroleum products. The length to be reconverted extends from Beaumont, Texas, to a terminal on the Ohio river near Moundsville, W. Va.

Project will cost $86,600,000, of which $14,800,000 is allocated for the little big inch reconversion. The remaining $71,800,000 will cover the cost of constructing a 382-mile pipeline and related facilities to maintain present gas pipeline capacity.

"The reconversion project for the little big inch will be set in motion at once," Mr Naff said. "And we expect that the line will initiate operation as a common carrier of refined oil products (including liquefied petroleum) by or before the fall of 1956."

Dynamo for first outdoor lights runs once more

► A DYNAMO that provided current for the first permanent outdoor electric lighting system in the U.S. ran again in June. It had provided the Cornell University campus with outdoor lights in 1878, well before their introduction in the great cities of the world.

It was turned on once more for the dedication of Phillips Hall, a new classroom-laboratory center for Cornell's School of Electrical Engineering.

The dynamo was built in 1875, as soon as a description of Z T Gramme's famous machine reached this country from Paris. Cornell Professor W A Anthony and student G S Miller did the work. The dynamo was exhibited at the Centennial Exposition in Philadelphia in 1876. Campus outdoor lighting began two years later, with arc lights sputtering illumination from the tower of McGraw Hall and from the original chapel's steeple.

Gas turbines will power Venezuelan oil project

► THE WORLD'S LARGEST gas repressurizing plant, now being built by Creole Peteroleum Corp seven miles out on

(*Continued on page 224*)

Poor FEEDING Spelled Trouble

Boiler feedwater line deposits and economizer corrosion in the boiler plant of a large Southern mill were serious problems when the Drew engineer was asked to investigate.

Solving their problem was not simply a matter of prescribing corrective feedwater treatment. Our study revealed that chemical feeding set-up contributed to the reported difficulties. Redesign of this system was required—and performed—a practical example of Drew engineering.

Designing and supplying chemical feed systems is one of the many engineering services we offer. For experienced, technical help on such problems—why not depend on your Drew man? There is no obligation.

DREW PRODUCTS

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, New York

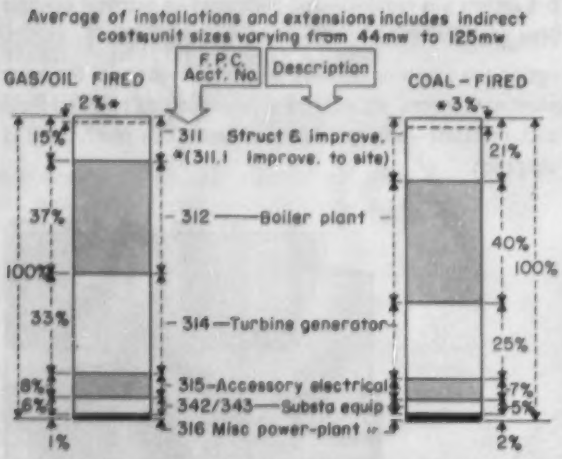
SAN FRANCISCO 11 • CHICAGO 1 • PHILADELPHIA 7 • BOSTON 10 • DALLAS • ASHEVILLE, N.C.
AJAX, ONTARIO

Service throughout the United States, Canada and South America

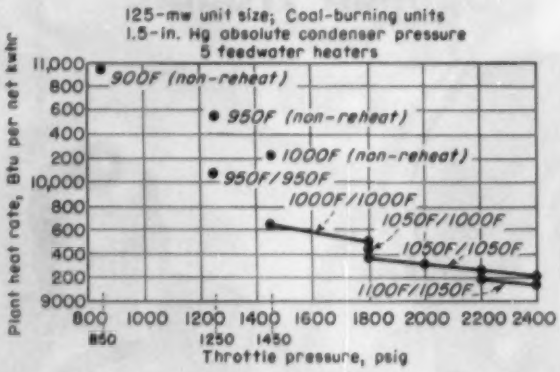
TECHNICAL BRIEFS

Latest engineering developments for busy power men

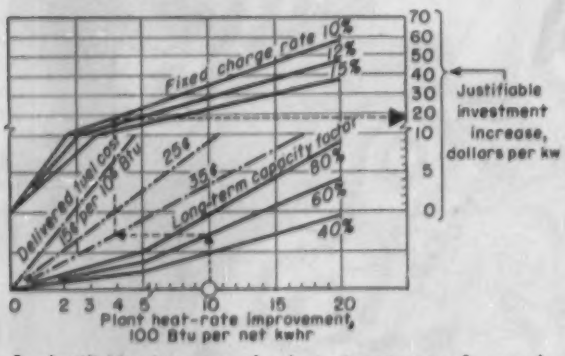
12 Digests for you on
CENTRAL STATIONS
FUELS AND FIRING
ELECTRICAL MACHINERY
ENGINEERING MATERIALS



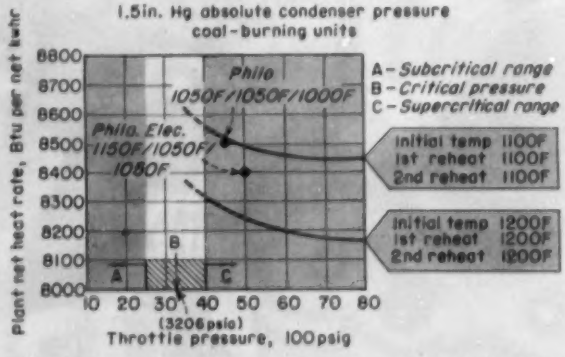
1 Typical steam station investment cost distribution



2 Estimated plant heat rates in the subcritical range



3 Justifiable increase of plant investment, $ per kw



4 Estimated plant heat rates in the supercritical range

How to design central-station plants for over-all economy

Central station design for over-all economy. *By Paul E Gourdon, Ebasco Services, Inc.*

Achievement of maximum over-all economy in central-station design is a most worthy goal—it always has been. There is, however, periodic need for repeated emphasis—the more so since capital costs are continually rising and fuel, production expenses and operating costs show no sign of decreasing.

The optimum in central-station design is to develop all the elements with the least investment in capital, with due regard to capacity requirements, reliability, safety, thermal efficiency, operating costs, maintenance and good over-all operational performance. It is seldom, if ever, that all these components can be realized at their optimum. Each situation must be handled on its own merits and compromises must be effected.

Major elements influencing economy are: planning, steam cycle, general design, enclosures and substructures, equipment specification, selection and purchase, construction and installation and equipment tests.

Fig. 2 shows estimated plant heat rates for a 125-mw unit using 5 feed heaters. Accuracy of the absolute values of plant heat rates is not of too great importance for this type of evaluation. The differentials at average operating conditions should be accurately estimated.

Heat-rate improvements when using supercritical pressures can be evaluated by means of Fig. 4. After establishing the capacity factor, fuel cost, fixed charge rate and plant heat-rate differential for the steam conditions being investigated, Fig. 3 permits evaluation of the justifiable increase of in-

Old hands at solving new insulation problems

Your **J-M Insulation Contractor** knows the answers that give you a better, more economical job

To be sure of getting the most efficient insulation for your plant or equipment, see the man with the world's most complete engineering and application service. He's your J-M Insulation Contractor who brings to every job the accumulation of Johns-Manville's 95 years' experience in the thermal insulation field.

J-M Insulation Engineers work hand in hand with J-M Insulation Contractors. Together they have achieved outstanding results with some of the most intricate insulation problems . . . of every type and size—in every industry.

J-M Insulation Contractors provide a complete selection of Johns-Manville quality materials. They will choose from their own stocks the best insulation for your conditions within the broad temperature range extending from minus 400F to plus 3000F.

Skilled application is a major contribution your J-M Insulation Contractor brings to every insulation job. His skilled mechanics have mastered the latest application techniques that assure you top-quality installation . . . give maximum operating economy and lower maintenance costs.

For undivided responsibility on all your insulation requirements, call your J-M Insulation Contractor. Write for the name of the one nearest you. Address Johns-Manville, Box 60, New York 16, New York. In Canada, Port Credit, Ontario.

Johns-Manville *first-in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION

More TECHNICAL BRIEFS

Begins on page 152

vestment in dollars per kilowatt for improved steam conditions. This is compared with an actual estimated cost difference, taking into account all elements such as the market prices of the turbine, boiler, feed pumps, other mechanical accessories and auxiliary electrical equipment. Fig. 1 shows station investment cost distribution with different firing methods. *APC paper; no number.*

Fuels and firing

Production of high-Btu oil gases from crude shale oils. *By E B Schulz, Jr, J J Guyer and H R Linden, Institute of Gas Technology.*

This interim report presents experimental data obtained in the thermal gasification of two typical crude shale oils in a 2.5-in. ID externally heated laboratory cracking tube, over a range of cracking conditions resulting in the production of gases with heating values from 900 to 1500 Btu per scf. Runs were made at atmospheric pressure, using steam for atomization and partial-pressure control, at cracking temperatures from 1400 to 1550 F, and residence times from 2 to 4.5 seconds.

The effects of severity of cracking on Btu recoveries in the form of stable product gas, and on yields and compositions of gaseous and non-gaseous products, are outlined in graphical form, and gasification results for crude shale oils are compared with similar data obtained for typical distillate and residual petroleum oils in earlier studies. The true (inert-free) product gas-heating value is used to define severity of cracking as determined by cracking temperature and residence time.

Data are presented on substitutability of scrubbed shale-oil gases, after dilution with inerts to give rated heat inputs, on critical appliance burners adjusted for high-methane natural gas. These data are correlated with the inert-free product gas heating value at various primary air adjustments, and are compared with equivalent results for high-Btu oil gases. *IGT paper; no number.*

The influence of gaseous fuels on modern industry. *By Frederic O Hess, Selas Corp.*

This paper attempts to explain the influence of gaseous fuel by citing examples of industrial operations that are internationally practiced. Another purpose is that of stimulating interest and appreciation of the true value and contributions of gas fuel. To obtain this effect the basic requirement of modern industry is defined as process control.

Some statistical data are included to establish the position of gas fuel in American industry and its rate of growth since 1938.

Examples illustrate use of gas by contribution to processing technique rather than by cost or production figures, because the latter cannot always be internationally correlated. Specific industrial processes cited in the paper illustrate influence of gas in seamless steel tube production, metals industry in general, chemicals, petroleum, metals foundry, glass, tin-can production and the printing and publishing industry.

From these examples the conclusion is drawn that gas is an important processing tool, and its application must necessarily increase with further development of industrial production. *WPC paper; no number.*

Low-temperature carbonization of lignite for a 240,000-kw steam electric power plant. *By V F Parry and W S Landers, Bureau of Mines.*

This paper discusses relative costs of certain fuels in Texas for generation of power and explains why Texas Power & Light Company and the Aluminum Company of America erected a 240,000-kw steam-electric power plant at Rockdale, Texas, to use processed lignite. A new process for drying and carbonizing noncoking coal, developed by the Bureau of Mines in Denver, Colorado, was introduced in this plant.

The paper describes and shows schematic designs of the drying and proposed low-temperature carbonization units and the integrated plant. Estimated fuel balance and properties of tar from this plant and similar plants operating on North Dakota lignite and Wyoming subbituminous coal, based on pilot-plant tests at Denver, are also incuded along with general data on low-temperature distillation assays of many low-rank coals studied by the Bureau of Mines. *WPC paper; no number.*

Suppression of burner oscillations by acoustical dampers. *By A A Putnam and W R Dennis, Battelle Memorial Institute.*

Tests on suppression of burner oscillations are described in this paper. The work was not all inclusive, but did produce several positive conclusions that may help in quieting particular combustion installations, or may be of help in preventing waste of effort in trying ineffective methods. Effectiveness of a quarter-wave tube was found critically dependent on length, but relatively insensitive to location, as long as the tube is placed in the region of the pressure antinode.

Similarly, effectiveness of a Helmholtz resonation depended critically on volume, for a particular neck, but is quite insensitive to location. In neither case did the suppressor have to be placed near the particular antinode where energy was fed into the oscillation. Degree of suppression obtained was approximately proportional to tube cross-sectional area; the same conclusion appears warranted with regard to the cross-sectional area of the throat of a Helmholtz resonator.

Almost complete suppression was obtained with holes drilled in the side of the tube and placed within 10% of a wavelength from a pressure antinode. It was found that hole diameter need not be greater than about 1/10 to 1/15 the diameter of the combustion chamber, but should be greater than the wall thickness, for best suppression. *ASME paper no. 54-A-174.*

Electrical machinery

Magnetic amplifier control of d-c motors. *By A Kusko, Massachusetts Institute of Technology and J G Nelson, Minneapolis-Honeywell Regulator Co.*

Although considerable work has been done on the operation of adjustable-speed d-c motors with armature power supplied by thyratrons, and by metallic rectifiers controlled with adjustable transformers, there is little information available on use of magnetic amplifiers for this purpose. For this reason, an analytical and experimental study was made of the steady-state operation of a d-c motor with armature power supplied through metallic rectifiers and controlled by saturable reactors or magnetic amplifiers. More specifically, speed-torque characteristics of the motor were determined for various control methods, and in particular, effectiveness of simple feedback connections and use of external armature-circuit inductance was ascertained in improving the speed regulation.

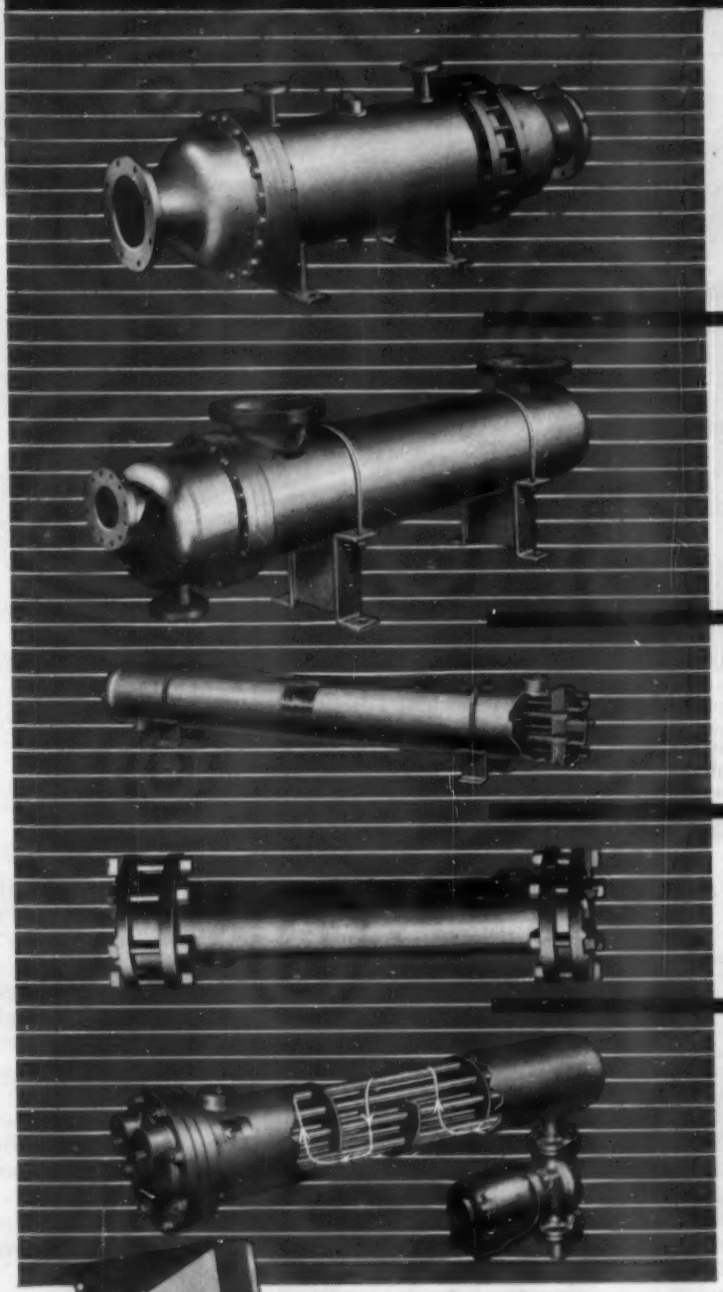
This study shows that where armature power for a d-c motor is being supplied by metallic rectifiers, adequate

(*Continued on page* 204)

Directions for ordering papers on p 212

B&G HEAT EXCHANGERS

...FOR EVERY TYPE OF SERVICE!



TYPE "OC" STRAIGHT TUBES

Sound design, plus precision manufacture, assure efficient operation. Removable tube bundle easily cleaned inside and out. Minimum free annular area and baffles with close tolerances reduce by-passing around the tube bundle. Other features include high tensile strength bolting, full thickness tube sheet and ample metal ligaments between tube holes. ASME quality at no extra cost.

TYPE "U" U-BEND TUBES

Recommended where the lower price of a single tube sheet unit is a necessary economy. These exchangers are also desirable where temperature differential across the tube bundle is extreme. Features include external gaskets, full tube bundle and close tolerance baffles for minimum by-passing. Metal ligaments between tube holes are extra large for internal strength. High tensile strength bolting. ASME quality fabrication.

FUEL OIL PRE-HEATERS

Reduce viscosity of heavy oils to permit pumping—control temperatures for proper atomizing of different oils. Units are available in straight tube and U-bend construction, for steam or water as the heating medium and with 2 to 10 passes.

GAS COOLERS

Efficient "air tube" design (air in tubes, water in shell) makes more effective use of cooling surfaces and reduces pressure drop. Cooling water is directed back and forth across tubes by baffles and moves in a direction counter to air flow.

TYPE "WU" WATER HEATERS

Produce large volumes of hot water from amazingly small units. Boiler water is pumped by a B & G Booster through the shell, greatly increasing the capacity of the heater. This also permits close control of service water temperature. Because of pumped circulation, connecting pipes and fittings are reduced in size, saving material and labor. "WU" Heater is instantaneous—no tank needed.

Send for this catalog of B & G Shell and Tube Heat Exchangers and Centrifugal Pumps.

BELL & GOSSETT

COMPANY

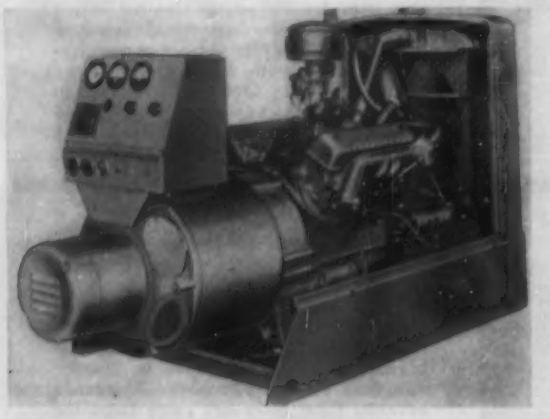
Dept. DZ-36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers

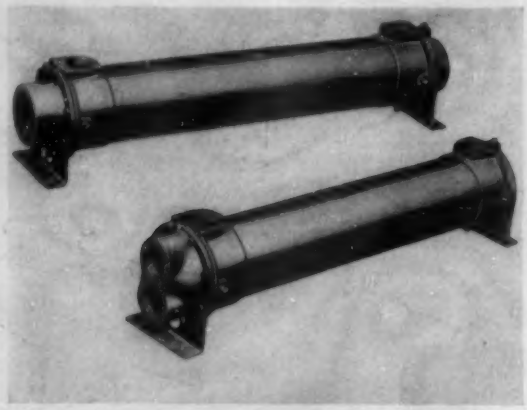


Ford-powered electric generating plants

802 • Compact electric generating units are powered by 6-cylinder (25 kw) and V-8-cylinder (35 kw) overhead-valve Ford industrial engines. The gasoline-driven units, with increased compression ratios and reduced friction factor, deliver more useable power on less fuel, manufacturer states.

Revolving field generators have ±2% voltage regulation and 3-cycle frequency regulation. Units are recommended for use in the construction industry and for emergency standby service in hospitals, public utilities, food-processing plants, or wherever economical independent electric power is essential. Complete information available on request to manufacturer.

D W Onan & Sons Inc, Minneapolis 14, Minnesota



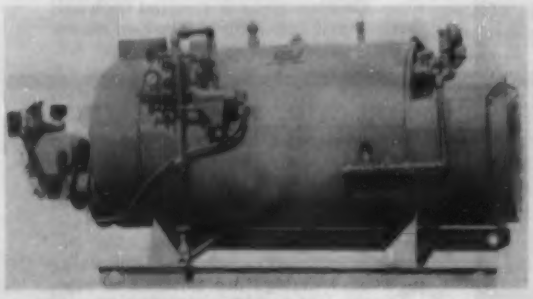
Heat exchangers for handling corrosives

803 • Stainless-steel heat exchangers are designed for heating or cooling corrosive liquids or gases. They have application in all industries where corrosive products or atmospheres for processing are encountered.

The fixed-tube bundle exchangers are available in single- and multi-pass models in a large range of sizes and capacities. Engineered to meet JIC Standards of the Hydraulic Industry, they are designed to eliminate expansion strains due to radical temperature difference, manufacturer states. Smooth-flow end bonnets provide least possible impact on tubes and tube sheets at inlet to tube bundle. Full data in bulletin 1155.

Young Radiator Company, Racine, Wisconsin

For more data on these items, use post cards page 165. Identify your request with item number.



Tankless instantaneous hot-water boiler

804 • Unit is designed for use wherever large quantities of hot water are required on short notice. It needs no storage tank, therefore fits into half the space normally required.

Nine models are available, ranging in capacity from 250 to 1000 gph, and 15 to 80 gpm for short periods. Units may be gas or oil fired. Also available are combination steam and hot-water models. Hot water is delivered at any temp to 200 F.

Indirect firing is said to eliminate burned out coils, and heat transfer is effected by a copper heat exchanger.

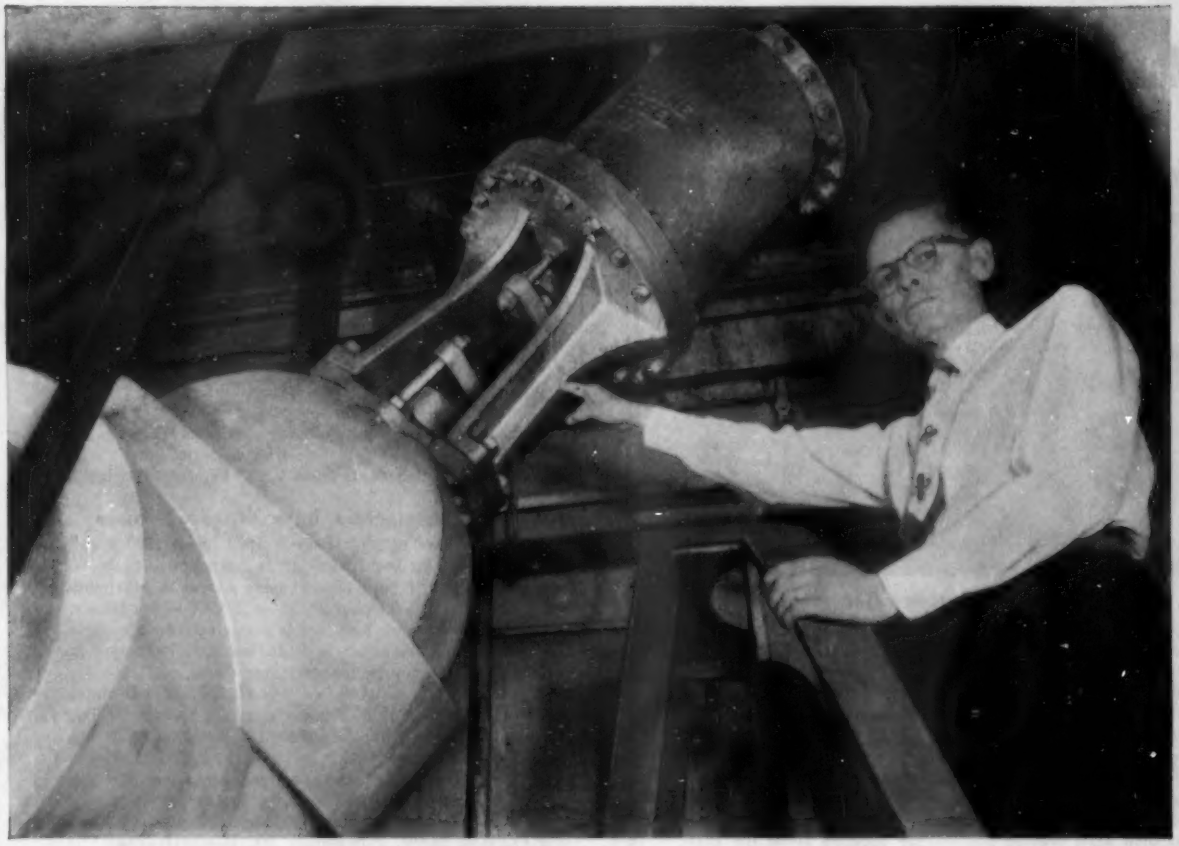
Mund Boilers, Inc, 1600 North Indiana Street, Los Angeles 63, California

Vibrating screen has lower silhouette

805 • Horizontal vibrating screen is especially suited for dewatering high capacity loads and sizing of material where headroom is limited. It has a much lower silhouette, although all advantages of high-intensity straightline action are retained, according to manufacturer.

Unit has two vibrators, one mounted on each side of screen at deck level for ease of inspection. Both are located at center of gravity to assure uniform vibration. As they do not project above sideplates, headroom is held to a minimum. Available in 4x8 to 6x20-ft sizes. Full details in data sheet 2562.

Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.



This CRANE VALVE begins new life after 37 years' service!

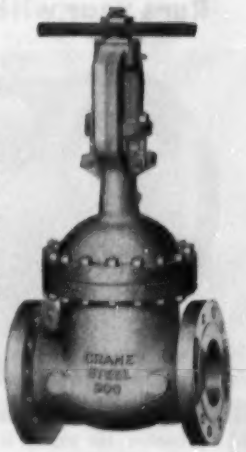
THE CASE HISTORY—World War One still raged when Cincinnati Gas & Electric Co. installed this Crane steel gate valve in 1917 at its Front & Rose Street Station. Ever since, it has safely controlled the main steam lead to No. 1 turbine—always making tight closure when needed—always responding smoothly to its hydraulic operator. For 37 years it has given such service with no more than routine maintenance—under operating pressure of 250 psi at 600 deg. F.

In 1954, the No. 1 turbine was renewed. The Crane steel valve —with complete confidence in Crane durable quality as demonstrated—was given limited preventive maintenance while down, and reinstalled in its original location.

Long life with minimum maintenance is a deeply rooted characteristic of Crane vaives. That's what makes them industry's first choice today for low ultimate cost.

CRANE STEEL GATE VALVES
... a complete line

Here is steel casting at its best, by the pioneer in steel valve development. Here is value in durability . . . dependable operation . . . and in low-cost maintenance that sets Crane steel valves apart from the ordinary. They're made for every service—in all pressure classes and sizes. Consult your Crane Catalog or Crane Representative.



CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

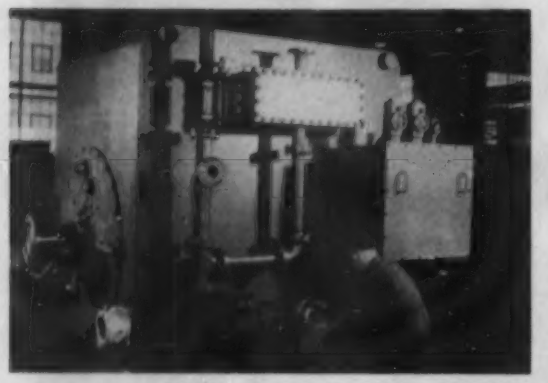
VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

More EQUIPMENT NEWS

Begins on page 156

For gas-contaminated areas . . .

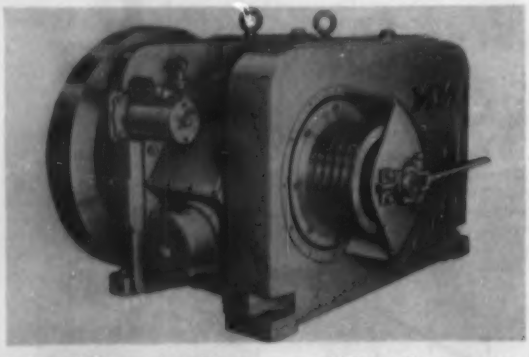


. . . inert gas-filled motors offer safe operation

813 • Units, available in a wide range of ratings, are designed for safe operation in hazardous gas-contaminated areas. Inert gas-filled enclosures utilize air-to-water surface heat exchangers to remove heat of motor losses. They differ from conventional water-cooled machines in that provision is made for maintaining an inert-gaseous atmosphere within the enclosures. Under positive pressure, non-explosive gas inside motor keeps out volatile ambient gases that could cause an explosion. To minimize gas replacement, inert gas-filled stator yokes are constructed of plate steel with gas-tight welds at all joints. Shaft extension seals prevent gas leakage outward along the shaft. Motors of this type, rated 3000 hp, 2300 v, 1800 rpm, are being supplied refineries to drive high-speed centrifugal compressors. Complete details on request to manufacturer.

Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

Runs year without servicing:



this 20-hp engine has new radial cooling system

814 • *Timeline 168* engine is designed to run continuously for a year without service, according to manufacturer. The 20-hp, 2-cylinder unit uses a new radial cooling system to replace conventional radiator. Also eliminated are water pump, pulleys, fan, fan belt and radiator hoses.

Water is circulated through a cast-aluminum cooling unit built into the flywheel. The cooling system has a 12-gal capacity. Channels in coolant reservoir increase circulation to maintain uniform engine temperature throughout.

After a year's operation, manufacturer states, only normal preventive maintenance is needed. Request full details.

Minneapolis-Moline Co, Box 1030, Minneapolis, Minn.

Deaerating heater for small plants

815 • Compact deaerating heater is designed specifically for use in small plants where economy and space requirements are of prime importance. Unit has a dual function; while heating feedwater to temperature of the operating steam, it also removes non-condensable gases such as oxygen and carbon dioxide from the feedwater. In addition, since steam is used in the deaeration process, plants can utilize exhaust steam or reduced pressure make-up steam for this purpose. Recovery of waste steam for use in the heater prevents loss of thermal energy and results in appreciable fuel savings.

The heater is a two-stage spray-type unit containing an internal vent condenser of stainless steel. Request details.

Graver Water Conditioning Company,
216 West 14th Street, New York 11, New York

High-voltage starters have 400-amp fuses

816 • Starters have ratings of up to 1500 hp at 2300 v and 3000 hp at 5000 v for both induction and synchronous motors. They can be applied on power systems having a maximum fault capacity of 150,000 kva at 2300 v or 250,000 kva at 5000 v.

Units utilize a 400-amp fuse that is a single unit with single mounting. It not only limits fault current but interrupts in less than one-half a cycle, manufacturer states.

Unit's air-break contactor, in ratings of 200 and 400 amps, is capable of interrupting 50,000 kva at either 2300 or 5000 v. Arc boxes are hinge-mounted to permit easy access to arcing contacts without removing other parts. Mechanical interlocks between both oil-immersed and air-break contactors and the fuse compartment door assures greater personnel safety.

Westinghouse Electric Corporation,
P.O. Box 2099, Pittsburgh 30, Pennsylvania

Refill oil filters feature opening cover

817 • Bulk-type filters feature a quick opening cover that simplifies changing of refills. Covers are fastened by swing bolts that, when loosened, swing down and release cover. On smaller models cover can be removed by one man. On larger models a cover-lifting device raises and swings cover to one side allowing unrestricted access to refills.

Filters are designed to operate on a by-pass or continuous re-circulation basis. They employ interchangeable bulk refills to filter a wide range of industrial oils including engine lube, hydraulic, turbine, quench and roll oils.

Filtration div, Houdaille-Hershey of Indiana, Inc,
98 South Avenue, Lebanon, Indiana

Indicator system determines smoke density

818 • Indicator system offers efficient method for keeping smoke discharge within limits of smoke control and air pollution ordinances. *Fireye System FE-3* consists of light source, photoelectric scanner and smoke-density indicator. Light source and scanner are installed on stack or breeching so that light beam is aimed directly at lens of scanner. Density of smoke obscuring light beam is measured and indicated directly on indicator in terms of both smoke density and Ringelmann Number. An alarm relay provides for operation of an external alarm at any preset value of smoke density.

Three smoke density recorders are available for use with the system. One may be used to make continuous recordings over a 24-hr period. Another provides 8-in. chart records of time and duration of excess smoke from two or more indicators. The third provides a continuous density record on a 12-in. chart. Request bulletin CM-32 for further details.

Combustion control div, Electronics Corp of America,
718 Beacon Street, Boston 15, Massachusetts

To obtain more information on these new equipment items, use post cards on page 165. Identify your request with item number.

GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

RUBBER and PLASTIC POWER and CONTROL CABLES

When you need Rubber and Plastic Power and Control Cables . . . look to General Cable . . . for every type, for every use . . . for fast deliveries . . . for UNMATCHED QUALITY! These General Cable products have earned an enviable reputation among users for transmission, distribution and control . . . for direct earth burial . . . for duct and conduit . . . for submarine use . . . and for self-supporting aerial applications.

As the biggest producer, General Cable makes the widest range of types. To mention a few: low and high voltage power cables, signal control and alarm cables, self-supporting aerial cables, interlock armored bus drop cable.

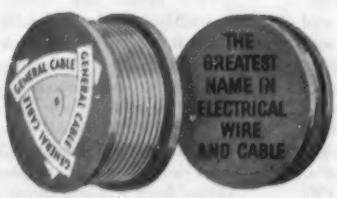
Constructions consist of copper and aluminum conductors. Insulations: GENCASEAL (Thermoplastic Vinyl), polyethylene, THERMAX W (moisture and heat resistant), AQUASEAL (heat and moisture resistant — low SIC), GENCORONE (ozone-resistant oil base), BUTARONE (ozone-resistant butyl base).

Outer coverings include rubber, neoprene, GENCASEAL, lead, reinforced neoprene over lead, and textiles (cotton, glass, asbestos, sisal, jute, rayon).

Armor finishes include steel, bronze, aluminum interlock; flat steel, and galvanized wire armor.

These popular and versatile products are made to meet *every* operating condition. Where standard types are not suitable for your particular use, special constructions will be made to meet your exact needs. Get the complete facts before you buy. Let our engineers help to solve your wire and cable problems. And, remember, that General Cable is the *only* manufacturer who can supply *all* your wire and cable needs!

GENERAL CABLE
CORPORATION



BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

GENERAL CABLE CORPORATION
Executive Offices: 420 Lexington Ave., New York 17, N. Y.

SALES OFFICES: Atlanta • Baltimore • Boston • Buffalo Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Erie (Pa.) • Greensboro (N. C.) • Houston • Indianapolis Kansas City • Lincoln (Neb.) • Los Angeles • Memphis Milwaukee • Minneapolis • New Haven • Newark (N. J.) New York • Philadelphia • Pittsburgh • Portland (Ore.) Richmond (Va.) • Rochester (N. Y.) • Rome (N. Y.) St. Louis • San Francisco • Seattle • Springfield (Ill.) Syracuse • Tampa • Tulsa • Washington, D. C.

More EQUIPMENT NEWS

Begins on page 156

Two welding units designed to ease maintenance problems

Maintenance welder is engine-driven

800 • Engine-driven welder is designed for pipeline welding and all types of construction and maintenance work. The unit is NEMA-rated for a current range of 40-250 amps and will handle all dc and ac/dc electrodes from 1/16 to ¼ in.

Welding performance, according to manufacturer, is featured by: (1) minimum load drop-off as welder heats up, (2) fast arc and response, (3) ease in arc starting and (4) high instantaneous recovery voltage that prevents popouts.

Liquid-cooled engine operates at 1750 rpm and has a 17-gal fuel tank that will keep the generator running over 13 hrs at full-load rating, 60% duty cycle, on a tank full of gasoline. Request bulletin GEC-1333 for complete information.

General Electric Co, Schenectady 5, New York

Generator-type welders are self-powered

801 • New line of gasoline-engine-driven generator-type welders are available in current ranges of 30 to 350 amps, ac or dc. One dc model is a dual-purpose unit that can be converted to an ac power plant by a conversion switch. The ac model also has a 110-v dc outlet for operating universal drills and lights. Another model is equipped with high frequency so that it can be used for Heliarc inert gas welding. All models have infinite current adjustment steps.

The air-cooled, 4-cylinder, 20-hp gasoline engine has electric starting and an internal fly-ball governor with a variable-speed control attachment. Full details available on request.

Westinghouse Electric Corporation, P.O. Box 2099, Pittsburgh 30, Pennsylvania

Three items of specific interest in the electrical field

Germanium power rectifiers

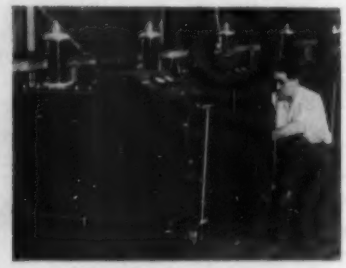
810 • Units are recommended for ac to dc power conversion where high power output, high efficiency, no aging and small unit size are required. They can be supplied for voltage ranges from 10 v to 100 kv and from 10 to 100,000 amps by connecting junctions and assemblies in series or parallel. Available as natural or forced convection and liquid cooled units. Bulletin GPR-1.

International Rectifier Corp, El Segundo, California

Vacuum tube voltmeters

811 • Instrument can be used for extended-range voltage, resistance and current measurement in both field and laboratory work. It combines accuracy of the basic voltmeter with a highly degenerative amplifier circuit. Accuracy on ac voltage is ± 3% of full scale for 1.0 v and higher ranges, and +5% of full scale for 0.3 and 0.1 v ranges. Detailed bulletin on request. Dept PR.

Technology Instrument Corp, 531 Main St, Acton, Mass.



Portable ac test sets

812 • Redesigned units provide smoothly-variable test voltages ranging from 0 to 50,000 v at 5 kva for high potential testing of electrical apparatus and insulating materials. Very high accuracy is obtainable in the range of 15 to 100% of the rated voltage. Unit is mounted on a 3-wheel truck and has a 15-ft supply cable. Operates at 60 cycles from a 230-v power supply.

General Electric Company, Schenectady 5, New York

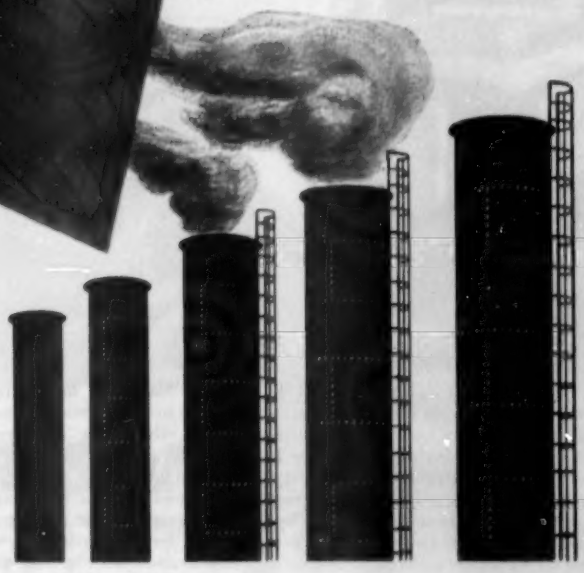
For more data on these items, use post cards p 165. Identify your request with item number.

precious BTU's can go up a small stack — too!

Whether heat is at work . . . or on its way up the stack — every BTU you generate costs you money. Heat recovery, therefore, is dollar recovery — *in any size boiler.*

Now with the Package Ljungstrom® Air Preheater, even boilers as small as 25,000 pounds of steam per hour can operate at fuel efficiencies never before practicable. Compact and self-contained, the unit operates the same as the large Ljungstroms so widely used in large industrial installations — waste heat is absorbed from flue gas by a rotating surface . . . transferred to incoming combustion air . . . and funneled back to the furnace — reducing your fuel costs 1% for every 45-50°F of preheat.

Find out how you can save with the Package Ljungstrom Air Preheater. Write to The Air Preheater Corporation.



New operating efficiency for small boilers

The Package Ljungstrom Air Preheater

- **Reduces fuel consumption . . . permits use of lower-grade fuels**
- **Increases boiler output and reliability**
- **Eliminates cold spots . . . keeps corrosion to a minimum**
- **Easy, fast to clean and maintain**
- **Comes *fully assembled — ready to be installed.***

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

More EQUIPMENT NEWS

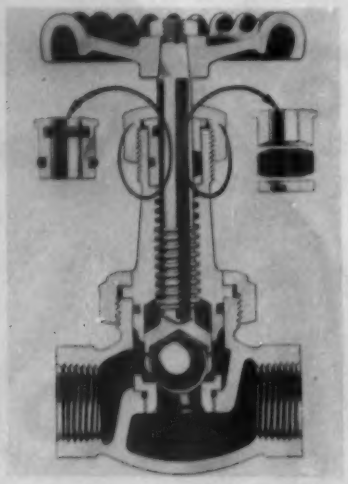
Begins on page 156

Four recent valve developments

Bronze ball valves

806 • Valves use four O-rings as seals to close every possible outlet for leakage, manufacturer states. Valve stem is sealed at top with one O-ring, stuffing box on outside with another, bonnet with another and one is placed under the seat. Optional steam packing is used to change valve from one service to another, as desired. Request descriptive bulletin for full details.

Carpenter Valves Corp, 6723 Denison Ave, Cleveland 2, Ohio



Manual reset valves

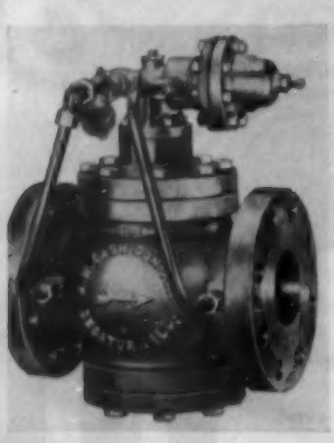
807 • Manual reset valves are designed for emergency safety services requiring quick, positive action. They may serve as a safety shutoff in either liquid or gas fuel lines, as a safe open valve for steam or foam fire snuffing systems, or to shut pipelines that indicate a line break by loss of pressure. Complete information available on request to the manufacturer.

Black, Sivalls & Bryson, Inc, 7500 E 12th St, Kansas City, Mo.

Automatic shut-off valves

808 • Manual reset valves are used to shut off flow of fuels in oil and gas burners in cases of faulty operation. Positive, leakproof closing action of these valves is said to provide maximum protection against burner explosion hazards. Manual reset mechanism prevents re-opening unless electric holding coil is energized. Request bulletin CV-31 for complete information.

Electronics Corp of America, 718 Beacon St, Boston 15, Mass.



Pilot-operated control valves

809 • Single-seat unit features easy conversion from a pressure reducing and regulating valve to a back-pressure control valve by simply switching control piping, manufacturer states. Dial-type range selector is used to select throttling range necessary to give most stable and sensitive control for the particular process application involved. Can be used with water, gas, air, light oils and refrigerants.

A W Cash Co, Box 551, Decatur, Ill.

New valve lubricant

819 • Multi-purpose valve lubricant is said to offer good metal-wetting qualities at both sub-zero and highly elevated temperatures. It is unusually resistant to mixtures of hydrocarbons in both acid and alkaline solutions, according to manufacturer. The lubricant has an "efficient temperature range" of –40 to 500 F in bulk form and –20 to 500 F in stick form.

It is recommended for hydrocarbon liquid and gas services including gasoline, kerosene, fuel and lubricating oils, crude distillate, sweet or sour natural gas and manufactured gas with water or organic condensate, dilute acids and alkalis, glycols, aqueous solutions and water. Write meter and valve div,

Rockwell Manufacturing Co, 400 N Lexington Ave, Pittsburgh, Pa.

Centralized lube valve cardboard demonstrator

Cardboard demonstrator shows the operation of company's standard *Dualine* valves. The valve has only two moving parts. As slide of demonstrator is pulled up, the 2-land piston moves up until lower diagonal passage is open. In actual operation, oil or grease under pressure in lower supply line causes this action. Lubricant under pressure continues through diagonal passage under main metering piston causing it to move upward displacing lubricant above it through upper diagonal passage and on through discharge line leading to the bearing. This is shown on the demonstrator when slide is pulled up as far as it will go. When slide is pushed down, same hydraulic action is depicted in reverse direction.

On back of demonstrator a volumetric conversion table and list of *Dualine* valve capacities is tabulated. Demonstrator is available on request to, *Farval Corp, 3269 E 80th St, Cleveland, Ohio.*

For details on these items use post cards p 165. Identify request with item number.

CHECK THESE TOO . . .

Steam trap testing device ..... p 170
Integrated control system ..... p 170
Cement lining for tanks ..... p 172
Balanced vibrating screen ..... p 172
Level-gage illuminator ..... p 174
Volume recording unit ..... p 176
Piston-type pressure switch ..... p 178
Explosion-proof motors ..... p 178

4TH COAL BRIDGE

installation at this plant

...proof of satisfactory performance

This new 17-net-ton man-trolley coal bridge is of typical modern Mead-Morrison design. It is a direct ship unloading and stocking bridge, with adjustable voltage control and equipped with a turntable on the man trolley.

This is the fourth Mead-Morrison coal bridge to be installed at this plant; two 12-ton similar bridges having been furnished in 1931, and a third 12-ton bridge furnished in 1942. These three previous installations, two of which are more than 20 years old, are still operating with complete satisfaction.

This new bridge was built in 1952 by the Canadian Mead-Morrison Division of United Steel Corporation Ltd. for the Hamilton Plant of the Steel Co. of Canada Limited.

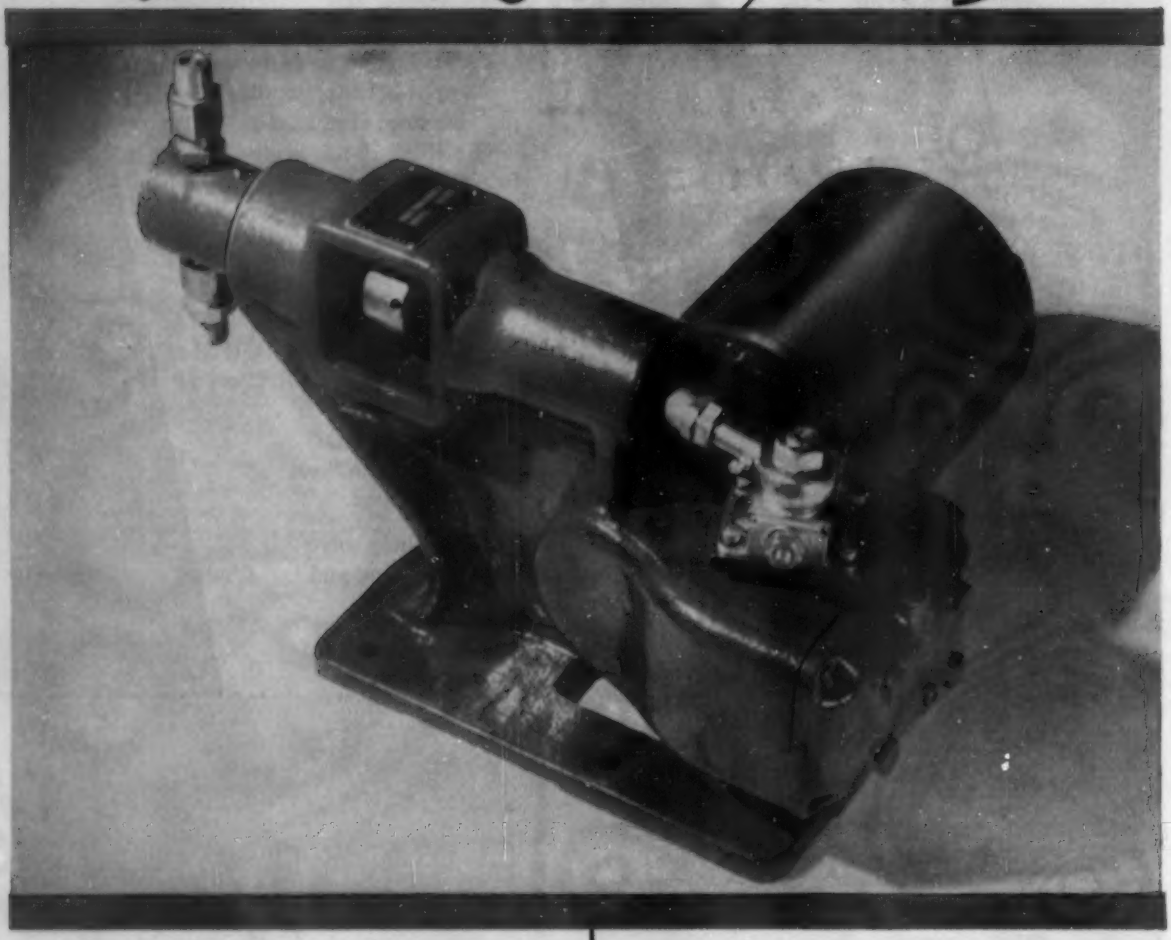
Let our engineers help solve your material unloading and rehandling problems.

MEAD-MORRISON

DIVISION OF McKIERNAN-TERRY CORPORATION · MANUFACTURING ENGINEERS · HARRISON, N. J.

Also builders of ore bridges, coal and ore towers, buckets, pile hammers, and special

Look!



NEW CHEMICAL PROPORTIONING PUMP

More pump for less money!!! Write for prices, capacities, and specifications on the new Proportioneers Model 1105-KH. Proportioneers, Inc., 354 Harris Ave., Providence 1, Rhode Island.

PROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.

METERS FEEDERS CONTROLS

TECHNICAL SERVICE REPRESENTATIVES IN PRINCIPAL CITIES OF THE UNITED STATES, CANADA, MEXICO AND OTHER FOREIGN COUNTRIES

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Dec. 1, 1955. Void after this date. 8/55

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Dec. 1, 1955. Void after this date. 8/55

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Dec. 1, 1955. Void after this date. 8/55

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This month's FREE Literature

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

HEATING AND AIR CONDITIONING

1 **Heating system.** Automatically-controlled vacuum steam heating system is described in 16-p bulletin 540. Single-dial selector controls entire system. Photos, performance charts, engr data. Illinois Engineering Co, 2035 S Racine Ave, Chicago 8, Illinois.

2 **Air filters** for compressed air and gases. Operation data, photos, diagrams, capacity charts in 8-p bulletin 117. R P Adams Co, Inc, 225 E Park Dr, Buffalo 17, New York.

3 **Centrifugal wet collector** for wet-dust control. Photos, line drawings, tables on tower-type units, presented in 4-p bulletin 919. Pangborn Corp, Hagerstown, Maryland.

4 **Centrifugal air washers** for wet-dust collection. Photos, diagrams, typical applications in 4-p bulletin W-555. The Ducon Co, 147 E 2nd St, Mineola, L. I., New York.

BOILERS AND AUXILIARIES

5 **Packaged steam generators.** Fully automatic units for oil, gas or combination; oil and gas high- and low-pressure. Photos, typical installations, design features in 4-p bulletin 514. Johnston Bros, Inc, Ferrysburg, Mich.

6 **Steam generating units.** Design data on indoor and outdoor installations of high-pressure, high-capacity units in 12-p illustrated bulletin S-55. Includes info on superheaters, economizers, airheaters, temp controls, steam purifiers. Springfield Boiler Co, 1901 E Capitol Ave, Springfield, Illinois.

COMPRESSORS AND ACCESSORIES

7 **Balanced opposed compressors,** 300 to 10,000 hp units (top range in tandem arrangement). Data on operation, drives, design, running gear, lubrication, valve action, capacity control, coolers and accessories in 36-p bulletin L-679-B1. Worthington Corp, Harrison, N. J.

8 **Single-stage compressors** for service or processes demanding air or gas compressed free of any lubricating oil. Two-page bulletins 604 and 605 contain sectional views and full information. Pennsylvania Pump & Compressor Co, Easton, Pennsylvania.

9 **Two-stage compressors.** Sliding-vane type for shop air, gas handling, drilling and other applications, are built in various sizes to deliver air at pressures from 60 to 125 psig. Cutaway views, table of ratings, dimensions in 4-p bulletin 16B8244. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wisconsin.

10 **Portable compressor** for use on-the-job. Illustrated 8-p form 2302 contains data of this 365-lb unit and also deals with the many tools it will operate. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

CONTROLS AND CONTROL SYSTEMS

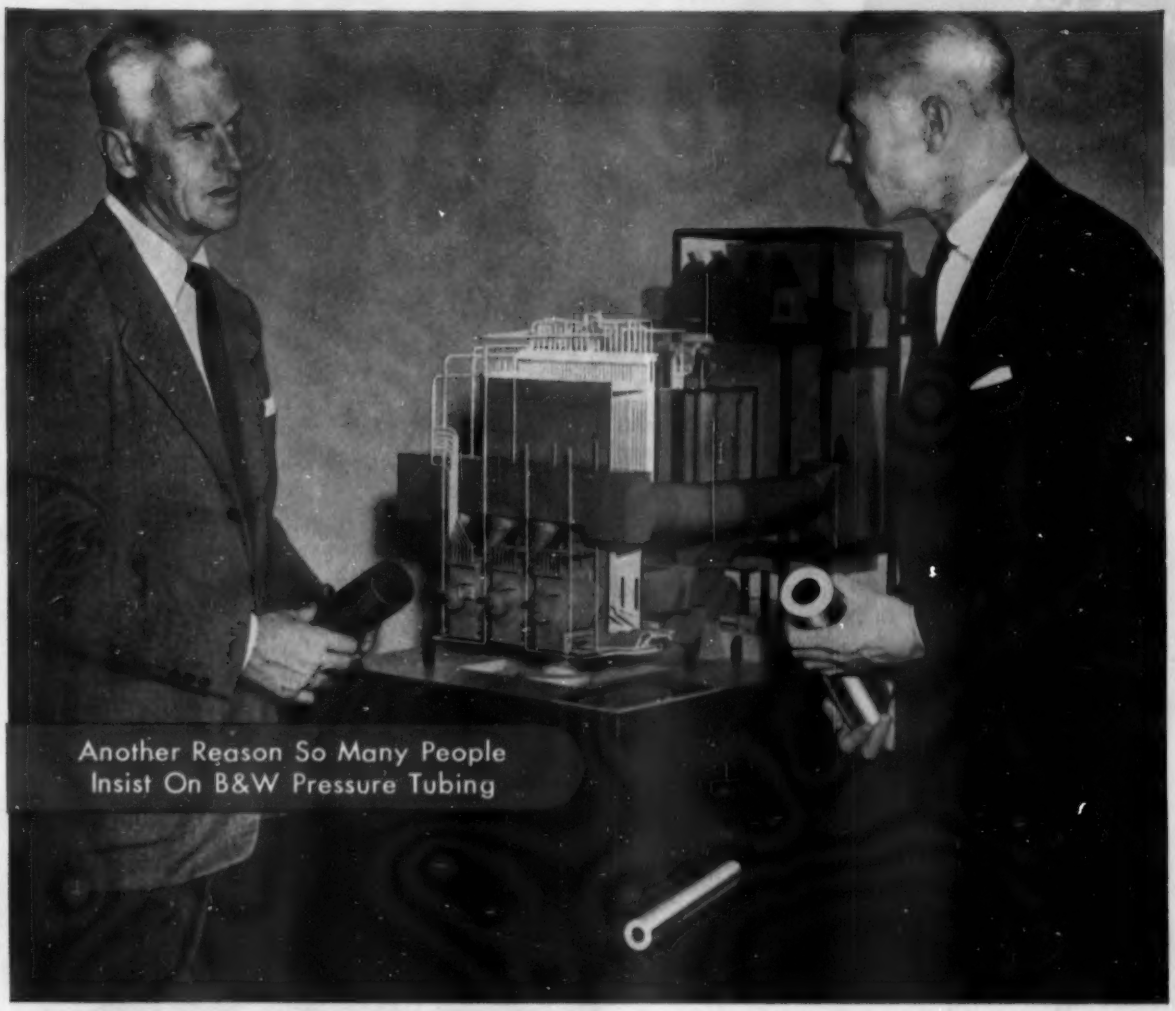
11 **Switches.** Illustrated 4-p bulletin describes features found on all switches from 30 to 200 amps. Murray Manufacturing Corp, 1250 Atlantic Ave, Brooklyn 16, New York.

12 **High-voltage motor control,** *Limit-amp,* is subject of illustrated 12-p bulletin GEA-6331. Outlines features of high-voltage, current-limiting, fused starters for coordinated control of squirrel-cage, synchronous, wound-rotor and multi-speed motors. General Electric Co, Schenectady 5, New York.

13 **Temperature monitoring system,** *Omni-guard,* is described in illustrated 8-p bulletin 3036A. Contains photos, diagrams, features, tables, full specs. Thomas A Edison, Inc, Instruments Div, West Orange, New Jersey.

14 **Pneumatic-electric transducer** provides automatic control of current input. Photos, diagrams, specs, dimensions in 4-p bulletin EB-1. Conoflow Corporation, 2100 Arch St, Philadelphia 3, Pennsylvania.

(*Continued on page 214*)



UNDER PRESSURE? TRY 4500 PSI AT 1150 F

There's a new concept in big boiler design: The Universal Pressure Steam Generator. It operates either below the critical—3206 psi—or smashes through the pressure barrier. A unit now being built has a design pressure of 5500 psi, delivers steam at 4500 psi and 1150 F. It's a "once-through" unit; put water in one end of a tube and steam comes out the other, without using a steam drum.

When B&W engineers designed this new boiler they turned to their own metallurgical and tubular products experience with alloys for pressure and temperature service to devise the tubing complex that is the heart of the unit. The chart shows the variety of analyses in sizes from 1-inch O.D. to 2½-inch O.D. and wall thicknesses from 0.10-inch to 0.55-inch.

Carbon Steel • Carbon Moly
Croloy ½ • Croloy 1
Croloy 1¼ • Croloy 2¼
Croloy 3M • Croloy 9M
Croloy 18-8

The best way to avoid operating under *personal* pressure on any job is to call for B&W Pressure Tubing. There's a grade, size, length and wall for virtually every pressure, temperature and corrosion resistance requirement. *Write for Technical Bulletin P.*

B&W
TUBULAR PRODUCTS DIVISION

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa. and Milwaukee, Wis.: Seamless Tubing, Welded Stainless Steel Tubing
Alliance, Ohio: Welded Carbon Steel Tubing
Milwaukee, Wis: Seamless Welding Fittings

TA-5028(P)

George Edwards' Scrapbook

How intelligent?

Best definition of an intelligent person that psychologists agree on is this: "A person who can adjust himself to most surroundings." So you may be smart, shrewd, cunning, alert, and have many other similar traits, but if you can't get along with people reasonably well in most situations, you are not as intelligent as you might be.

Sure, you may know more engineering than your subordinates. But if your plumber, for example, can work with most people or get them to cooperate with him and like him, and you can't, he is considered your superior in intelligence. If he could get along with a group of head hunters in New Guinea and you couldn't (without losing your head) again he is the man.

Of course, there are various shades or degrees of intelligence. But I certainly have had an inferiority complex since hearing this definition. When I think of how well the labor foreman in our town's railroad yard gets along with his gang of nondescript characters, and how hard they work for him, I can see he is superior in many ways. I'm sure most of us couldn't work with some of his men.

Only for the birds

Scientists who dislike the restraints of highly organized research like to remark that a truly great research worker needs only three pieces of equipment: a pencil, a piece of paper and a brain. But they quote this maxim more often at academic banquets than at budget hearings.

—Don K Price, *Government and Science*

Do your ideas go over?

Unless you can express your ideas in writing and in speaking, don't expect to reach the top—that is, unless you're another Einstein or Newton.

Reason why you must get your ideas over in talking and writing is that soon as you move one step up from the bottom rung, your effectiveness depends a lot on your ability to reach others through the spoken or written word. And that means speaking and writing well.

When New York's late governor Al Smith was questioned about Franklin Roosevelt's second election, he could have answered in typical political double talk: "Due to the great amount of pump priming by the New Dealers, it is difficult to understand how the American people could possibly vote for anyone but the same party so long as that party continues its wasteful policy of giving away the public treasury to keep everyone happy."

But Al Smith didn't say that. He commented simply, "People don't shoot Santa Claus." Most of us have quoted that remark many times. It went over with a bang because it tells more than volumes written or said on the subject.

Must you be tied?

My dad often drove me, as a very young lad, out to his brother's place near Martinsville, Indiana. One thing I'll never forget on that farm was a young jersey cow. First time I saw my uncle milk that animal, I noticed the cow had a short piece of rope tied around her right hind leg. The rope was only a foot long and both ends were loose, looked more like a bow tied there for decoration.

"Why the rope on that cow's leg, Uncle Fred?" I asked, thinking someone was playing a joke.

"Oh, that," he laughed. "You see, George, I raised this critter from a calf. And the first time I tried to milk her she kicked the milk bucket. She did that every time until I tied her leg to the stall. About six months later I tied the rope to her leg but forgot to fasten the other end. To my surprise, she didn't kick. But when I left the rope off altogether, she kicked like blazes again. So now I just tie that short rope on her leg and there's no trouble."

That cow reminds me of some people. Uuless you pretend to hold a club over their head, they take advantage of you. If put on their own, you can't tell what they may do. But as long as they believe someone with authority is around, they'll work their heads off. I've often wondered why all people aren't more intelligent than some cows?

Machinery creates jobs

Jobs in manufacturing have increased 70% since 1939, while our population went up only 22%. Jobs have doubled in the automobile industry since 1939, increased 75% in electrical equipment. And did you know that today there are more jobs in instruments for measurement and control than there were in the entire auto industry 20 years ago? This all shows that more production creates more wealth, which in turn means jobs for all of us.

Those who can't see the over-all good a new machine does should think of the millions in backward countries where human beings even pull plows. A new machine may put us out of our present jobs, but it adds jobs elsewhere.

George Edwards
Engineer

THINK *Klingerwise*

USE *Klinger*

SHEET PACKINGS

"KLINGERIT" The universal sheet packing for superheated and saturated steam, hydraulic pressures, compressed air, gases, chemicals, oils, spirits, solvents and hydrocarbons.

"KLINGERIT 1000" Wire-reinforced sheet packing for all purposes, especially recommended for extremely high temperatures.

"KLINGER-ACIDIT" Acid-resisting sheet packing, produced especially to resist hot nitric, hydrochloric and sulphuric acids, and all other organic and inorganic acids.

"KLINGER-OILIT" Oil-resisting sheet packing, primarily intended for use in the oil refining and distributing industries, as well as for use with refrigerants such as methyl chloride, sulphur dioxide and ammonia.

"RK" A good quality compressed asbestos sheet packing, suitable for general engineering practice, particularly in cases where the use of such a high grade material as "Klingerit" is not justified.

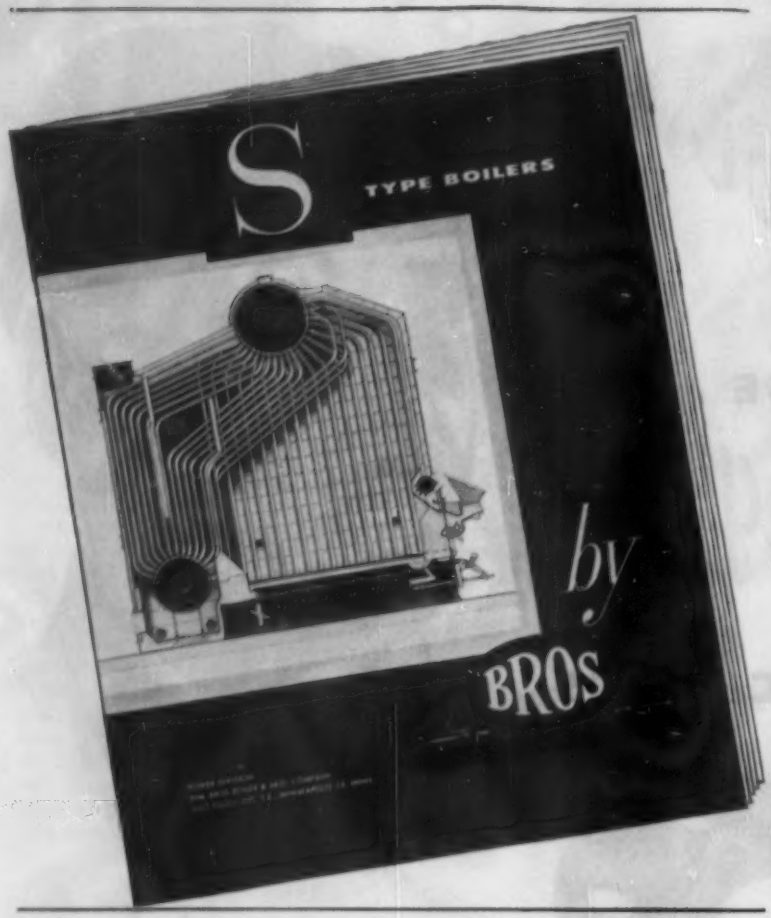
Write for the Klinger Master Catalog which describes the complete range of Klinger products, seatless piston valves, sleeve-packed cocks, reflex and transparent level indicators, natural, synthetic and silicone rubber and plastic products, and compressed asbestos sheet jointing for every purpose.

FIRST IN 1886
FOREMOST TODAY

RICHARD KLINGER LIMITED, KLINGERIT WORKS, SIDCUP, KENT, ENGLAND
Cables: Klingerit — Agents throughout the world — Telephone: Foots Cray 3022

Manufacturing Licensees for Canada
JOSEPH ROBB & COMPANY, LIMITED
5575, COTE ST. PAUL ROAD, MONTREAL, 20, CANADA
Telephone: WILLARD 3181 — Cable: ROBCO
Branches at SYDNEY, HALIFAX, OTTAWA, TORONTO, HAMILTON, WINNIPEG, EDMONTON, VANCOUVER, QUEBEC CITY.

Manufacturing Licensees for U.S.A.
THE KLINGER CORPORATION OF AMERICA
95, RIVER STREET, HOBOKEN, NEW JERSEY, U.S.A.
Telephone: HOBOKEN 3-7515 — Cable: KLINGDALE
Distributors and Agents in principal cities.



A higher standard for standard boilers!

Boilers, no matter what the application, can be very much alike in basic design. However, the Bros "S" Type Boiler (illustrated above) has in it many distinct features, selected over years of experience which result in:

1. *Higher burning efficiency*
2. *Lowest possible maintenance costs*
3. *Minimum space requirements*
4. *Simplified installation*

Bros "S" Type Boilers are pre-engineered to use standard components. This permits faster delivery and field assembly at a much lower cost.

If you are planning a new plant . . . expanding . . . or replacing an old unit, be sure to get full information on Bros "S" Type Boilers. Capacities range from 10,800 to 50,000 lbs. per hr. with design pressures up to 600 psi.

Write today for your copy of the new "S" Type brochure. It contains complete specifications and drawings.

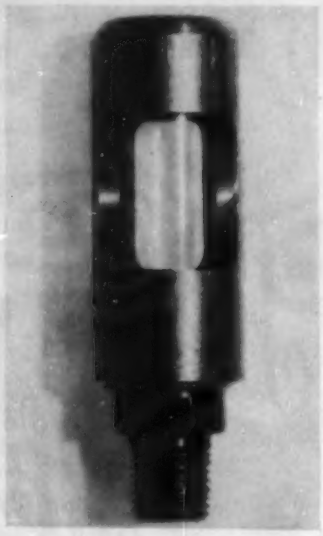
POWER DIVISION—WM. BROS BOILER & MFG. CO.

1057 Tenth Avenue S.E. BROS Minneapolis 14, Minnesota

DESIGNERS AND MANUFACTURERS OF WATERTUBE BOILERS, 2-3-4 DRUM AND PACKAGED DESIGNS, AUXILIARY EQUIPMENT, AND A FULL LINE OF INDUSTRIAL STOKERS.

More EQUIPMENT NEWS

Begins on page 156

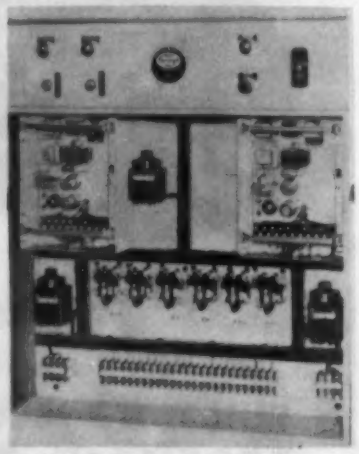


Steam trap testing device

820 • *Vis-a-plug* unit is a transparent test plug used to check steam traps at a glance. Unit is installed as a permanent part of the trap by removing pipe plug in test plug opening. It is designed for steam service of 250 and 450 psi, and is hydraulically tested for 800 psi. Unit has no moving parts and is self cleaning. Full data obtainable on request to the manufacturer.

R & R Co, Box 77, Sharon Hill, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.



Integrated control system

821 • *Fireye* integrated control system is especially designed for safe lightup and operation of multiple-burner boilers. It consists of a prewired and tested control cabinet assembly, shown above, plus all necessary controls, timers, valves and accessories for complete installation.

System provides starting and operating flame failure protection for one to four burners: gas, oil or gas-oil fired; manually or semi-automatically ignited. Flame fail-

THERE'S ONLY ONE OIL "just as good"

When you're offered substitutes for Gargoyle D.T.E. Oils, remember these facts—

We're mighty proud that, so many times, you're told some other oil is "just as good as Gargoyle D.T.E." This is high praise—additional proof that Gargoyle D.T.E. hydraulic oils set the *standard of performance* in their field!

Gargoyle D.T.E. oils are uniformly high in quality—have been continuously improved for over 60 years to meet advanced machine designs. Premium products, their initial cost is only slightly higher than ordinary oils—often only about *one mill per hour* of machine operation!

Actually, Gargoyle D.T.E. hydraulic oil is more economical in the long run because... 1) it lasts longer—has stayed in service for thousands of hours in many cases... 2) increases machine efficiency... 3) improves production... 4) reduces manufacturing costs.

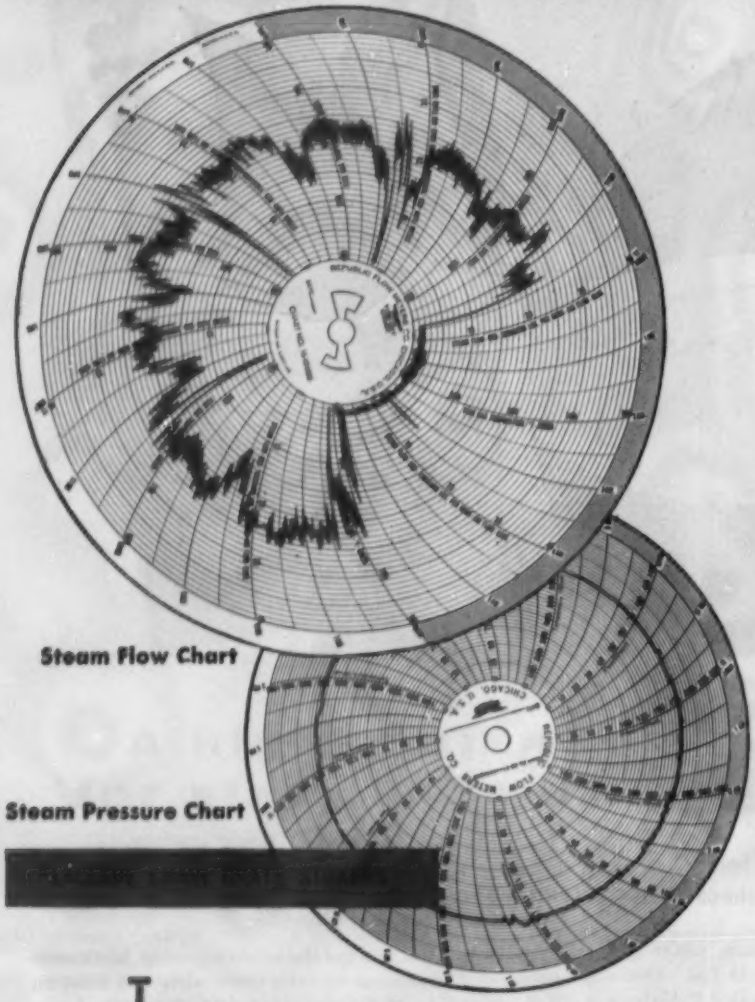
Remember, too, you get the world's greatest lubrication engineering service—*at no extra cost*—when you insist on Gargoyle D.T.E. oil. Why accept less? Call us today!

SOCONY MOBIL *Correct Lubrication*

FIRST STEP IN CUTTING COSTS

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION
Formerly Socony-Vacuum Oil Company, Inc.

Laclede Stokers* Quickly Respond to Wide Load Fluctuations



Steam Flow Chart

Steam Pressure Chart

These charts, from the files of one of our customers, clearly indicate the ability of Laclede Chain Grate Stokers to quickly respond to widely fluctuating loads.

For five hours during the night, the steam flow was only 1000 lbs./hr. When the first shift started to work, the steam flow quickly increased to 23000 lbs./hr. As seen from the pressure chart, the response of L.C.G.* resulted in the header pressure remaining constant at 175 lb./sq. in.

Fast response, dependability and economy are three of many outstanding features of Laclede Chain Grate Stokers.

Write for Bulletin #5010 M.C.

FOUNDED IN 1904

LACLEDE STOKER COMPANY

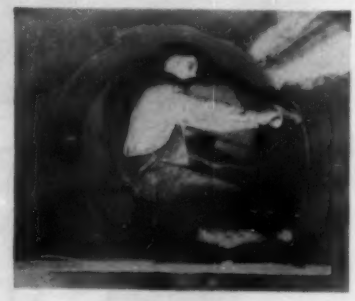
4440 HUNT AVE. · ST LOUIS 10, MO.

More EQUIPMENT NEWS

Begins on page 156

ure protection is provided for each burner by two scanners; one monitors the pilot flame and the other the main flame. System does not allow main fuel valve to open until pilot flame is established. It makes mandatory a purge time of sufficient length to produce four air changes in the boiler, at the end of which time a green light flashes to show operator he may continue the "light-off" procedure. Request bulletin CC-31 for complete information.

Combustion Control division, Electronics Corp of America, 718 Beacon St, Boston 15, Mass.



Cement lining for tanks

822 • Cement lining is recommended for restoring corroded water-storage heaters and steel tanks. It is a blended cement formula that will not shrink or crack and is not subject to high temperature failures, manufacturer states. Called *Pre-Krete*, it is applied with a trowel to a thickness of ½ in. After the lining has "set," a small amount of water is placed in the tank and the manhole closed. In such a moisture-laden atmosphere, *Pre-Krete* will cure in 24 hours. Full details on request.

Pocono Fabricators, Inc, East Stroudsburg, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.

Balanced vibrating screen

823 • Dual-deck balanced vibrating screens operate at relatively low frequency of 1000 vibrations per minute. Its high amplitude stroke of 5/16 in. provides efficient de-watering, scalping, de-dusting, coarse and medium sizing of materials such as coal, stones, ores, etc. Units are available for either suspension or floor mounting and can be installed horizontally or declined. They can be provided in any specified length.

Drive motors are normally mounted on an outrigger frame on either side of the frame of floor mounted screens. On suspended type screens, drive motor is

J. M. CRAWFORD, VICE PRESIDENT AND GENERAL MANAGER OF MOTOR & GENERATOR DIVISION, AND A. H. LAUDER, MANAGER OF LARGE MOTOR & GENERATOR ENGINEERING, INSPECT NEW G-E DEVELOPMENT LAB.

In new G-E development laboratory giant motors perform just as in service

One of the most difficult problems design engineers face is predicting accurately how a large motor will perform under actual operating conditions. G.E. has come up with an answer to this problem.

INCREDIBLY ACCURATE TEST CONDITIONS are made possible by the brand new G-E test laboratory pictured above. A huge synchronous generator with a base rating of 60,000-kva, driven by a variable speed d-c motor, provides current of variable frequency to the equipment on test.

Large a-c and d-c motors and generators, synchronous condensers, and giant hydro-generators can now be fully tested under conditions more severe than are encountered in the field. You are thus assured your G-E equipment will give you the maximum of long life and efficient operation.

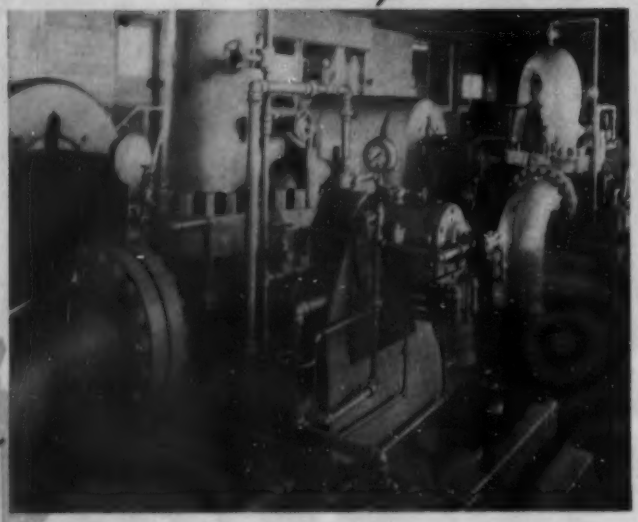
UNDER THIS TEST LAB REALISM, data will be obtained which can be translated by G-E engineers into further design improvements.

Take advantage of this progressive research and bring your large motor and generator problems to General Electric. For more complete information call the nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y. 770-18

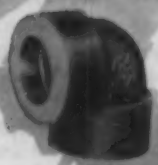
Progress Is Our Most Important Product

GENERAL ELECTRIC

WATSON-STILLMAN FORGED STEEL FITTINGS



WORK BEST...under pressure



■ In high pressure steam lines...process liquid and gas piping...hydraulic fluid lines...wherever strong, tough pipe joints are needed, Watson Stillman Forged Steel Fittings provide a safety factor against costly piping failures. They resist pressure, heat, corrosion, shock and vibration because they're drop-forged of high quality steel to produce a dense, tough, forged-fiber structure that can really take it.

Extra strength is built into W-S fittings in other ways too...such as the heavy reinforcing bands extending well beyond the threads or sockets.

Protect your high pressure piping system with Watson-Stillman Forged Steel Fittings. Available in carbon, stainless and alloy steels, in Screw-End and Socket-Welding Types to meet your service requirements. Send today for Free Catalogs.

Bulletin A3-50—Forged Steel Fittings
Bulletin S-1-55—Stainless and Alloy Fittings
Bulletin U-1—Forged Steel Unions
Bulletin S-3-55—150 lb. Stainless Fittings

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

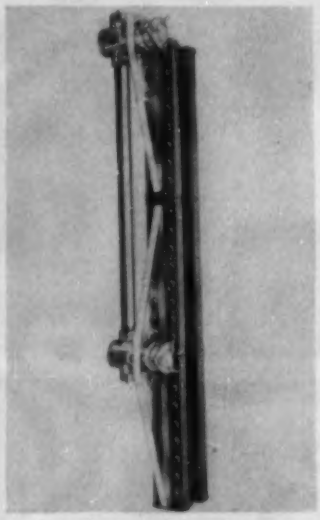
H. K. PORTER COMPANY, INC.
Roselle, New Jersey

More EQUIPMENT NEWS

Begins on page 156

mounted above the top decks, but can be separately mounted below and on either side of the bottom deck. Both units use a 5-hp motor for starting the inert masses in motion. However since springs and two decks work close to the natural resonance of the system, once running the only power required is that necessary to keep the springs moving. Details on request.

Syntron Co, Homer City, Pa.



Level-gage illuminator

824 • Manufacturer states that these gage illuminators give an even diffusion of light over the entire length of gage glass, with no glare spots or blinding areas. They incorporate principle of solid-wedge lighting combined with plastic. Illumination from a single light source is reflected from the angular surface of a ¾-in. thick plastic wedge and flows with evenly diffused intensity through the transparent gage glass. Plastic wedge is mounted in an improved way, leaving a space between wedge and glass, to facilitate cleaning. This also leaves an air-cooling space that allows illuminator to be used on higher temperature gages. The illuminators are available as explosion-proof or non-explosion-proof models. Standard models operate on 110/120 volts ac or dc. Descriptive catalog on request.

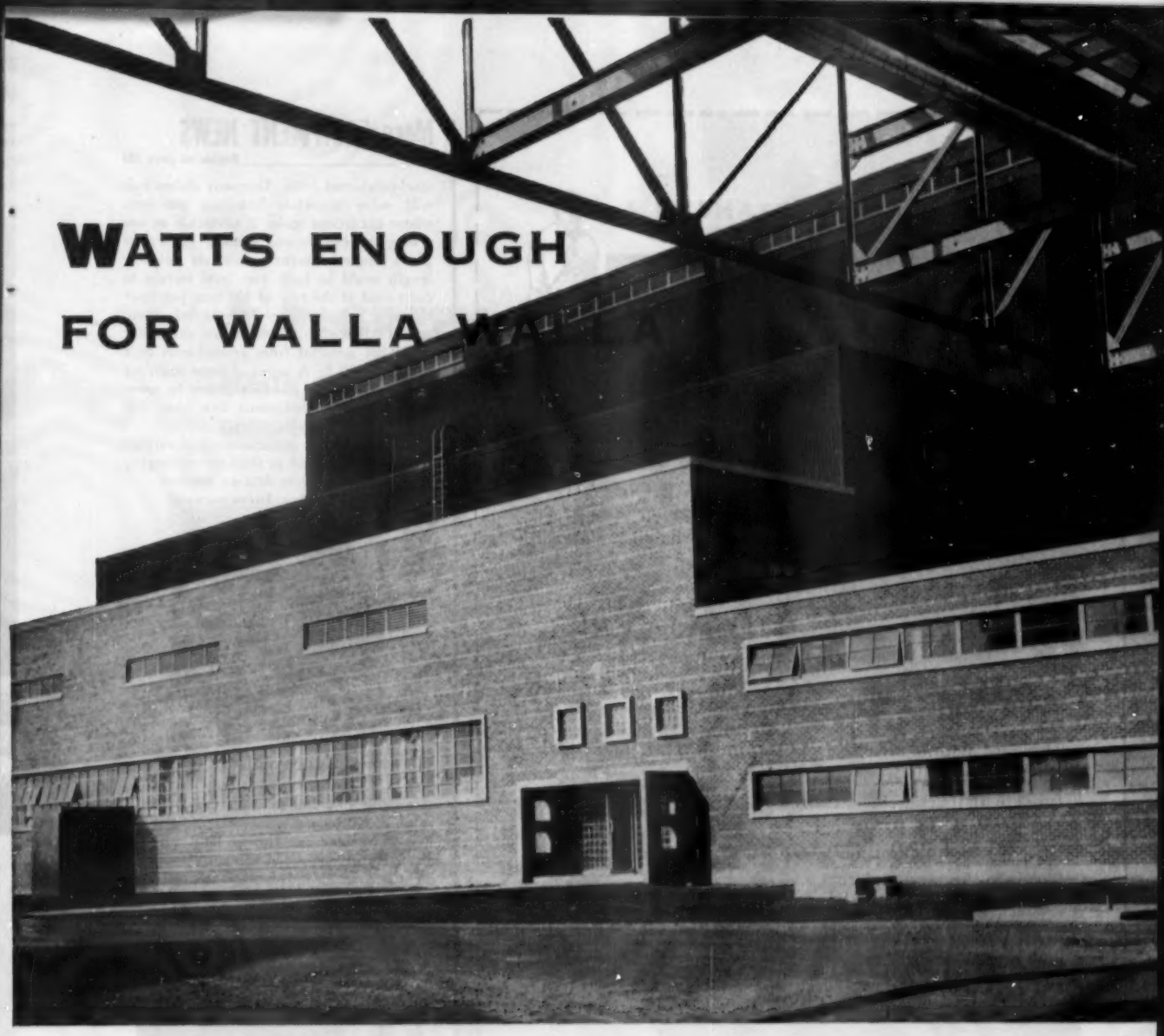
Jerguson Gage & Valve Company, 80 Fellsway, Somerville, Mass.

For more data on these items, use post cards p 165. Identify your request with item number.

Conveyor belt

825 • Manufacturer claims new conveyor belt is 400% stronger than conventional cotton reinforced belts. It is recommended for transporting coal, ore, crushed stone and other bulk materials over long distances and up steep grades.

The belt, reinforced with a synthetic fabric called *Super Raynile*, is pliable and flexible despite its high strength. Manufacturer reports it is less expensive than steel-reinforced belts and can be spliced quickly and economically in the field without special equipment such as is required to splice



This power plant could furnish utilities for a city the size of Walla Walla, Washington, with watts to spare. Its 12,000 kw. generating capacity supplies electricity for all of the facilities of the National Petro-Chemicals Corporation's Tuscola, Illinois installation. Three boilers feature economical, exterior installation, produce 600,000 pounds of steam per hour.

The plant was designed, engineered and built by Pritchard . . . under the popular Pritchard Single Responsibility Contract . . . working with the company's staff.

When you plan for construction, modernization or expansion of your power plant, take advantage of Pritchard's proved ability and complete facilities. Write today for complete information.

INDUSTRY'S PARTNER FOR PROGRESS

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

BOSTON, BUFFALO, CHICAGO, HOUSTON, NEW YORK, PITTSBURGH, ST. LOUIS, TULSA

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 464, 4625 Roanoke Parkway, Kansas City 12, Mo.

THE *Pitch* IS IMPORTANT IN A

WARREN-QUIMBY SCREW PUMP

The capacity of this pump is determined by the "*pitch*" *of the screws* and the full load speed of the motor. Expert engineering knowledge of just the right pitch, number of threads, experience data, and precision workmanship are all mighty important in this highly specialized type of pump. It is available in two general types:

Gear-in-head, with internal gears and bearings, for handling lubricating liquids free of corrosive elements and solids.

Double External Bearing and Gear, with separately lubricated gears and bearings, for handling all other liquids.

Standard pumps include jacketed, unjacketed, horizontal, vertical pedestal, vertical bulkhead, long body and hopper types in all machinable metals. Capacities, up to 3000 g.p.m. and pressures up to 700 p.s.i. on low viscosity liquids, and practically unlimited for high viscosity liquids which will flow into the pump inlet.

For specialized services involving hard-to-handle materials, insist upon Warren-Quimby, the original Screw Pump . . . now owned, greatly improved, manufactured, serviced and guaranteed by Warren . . . one of the pioneers of the Pump Industry.

Centrifugal • Reciprocating • Rotary

WARREN QUIMBY PUMPS

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

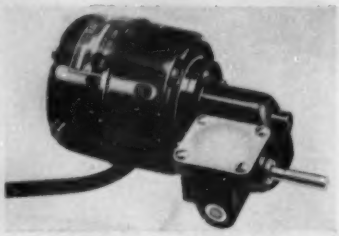
More EQUIPMENT NEWS

Begins on page 156

steel-reinforced belts. Company claims belt will solve materials handling problems where conditions make it advisable to use a long conveyor in one section. For example, a single conveyor section six miles in length could be built over level terrain to carry coal at the rate of 400 tons per hour by using a 6-ply *Super Raynile* belt 30-in. wide. A belt of this construction and width could lift material from ground-level to a height of 850 ft. A series of these conveyor sections could be linked together to move materials in a continuous flow over distances of hundreds of miles.

The belt will be manufactured in various widths to 72-in. and in thicknesses ranging to 15 plies. Complete data on request.

Hewitt-Robins Incorporated, Stamford, Connecticut



Gear reducer

826 • Gear reducer is available in any voltage to 250, and in speeds as low as 1 rpm. It is designed to meet loads to 15 in. lbs. The motor can also be built with an electric governor speed control. It can be rheostat controlled, dynamically or mechanically braked. Further information available on request to manufacturer.

Rae Motor Corp, Box 291, Racine, Wisconsin

For more data on these items, use post cards p 165. Identify your request with item number.

Volume recording unit

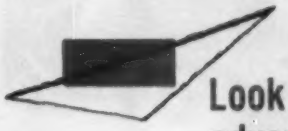
827 • *Volumeter* is a device for recording weight of material on a continuously moving conveyor even though it may stop at undetermined intervals. Relying on constant volume of material being conveyed, the *Volumeter* can be calibrated to record precise integrations of any conveyor load. If volume of material on conveyor should vary, device will automatically shut down the conveyor.

Unit is mounted on conveyor housing. Its wheel, mounted on a pivoted yoke, rides freely on the material being conveyed. A cam on end of the shaft actuates a relay switch. The counting impulse thus produced is carried electrically to a remote

A. P. GREEN

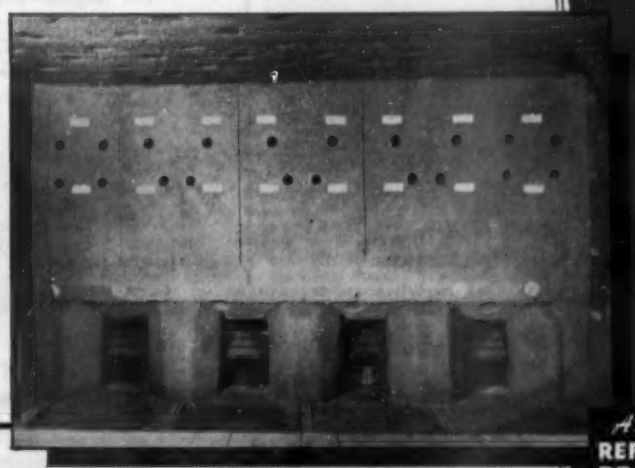
PLASTIC FIREBRICK

GIVES LONGER, TROUBLE-FREE SERVICE

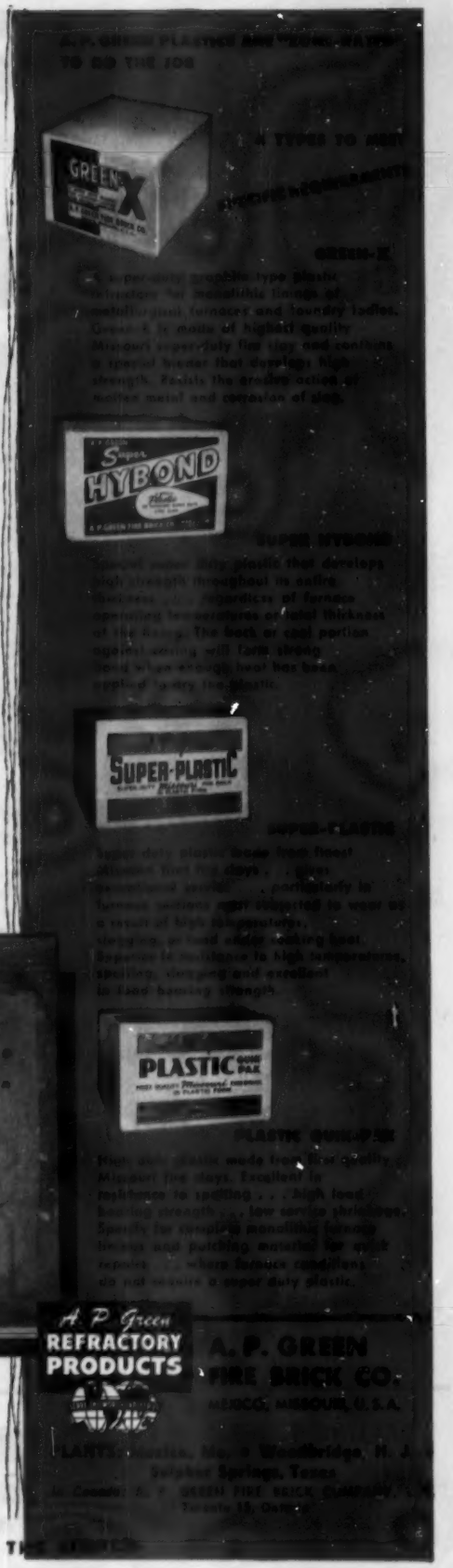


Look at these advantages

1. **Joint-Free Furnace Linings**
   present a solid monolithic front to slag and furnace gases.
2. **Elimination of Air Infiltration**
   lowers fuel cost and increases efficiency.
3. **Adaptable to Any Thickness or Contour**
   eliminating need for special refractory shapes.
4. **Freedom for Expansion and Contraction**
   with A. P. Green floating anchors.



View of monolithic Super-Plastic front wall showing stoker openings, stoker piers, and ignition arch.



WAREHOUSE STOCKS FOR PROMPT DELIVERY

Look in the Classified section of the telephone directory, or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK CO.

MEXICO, MISSOURI, U.S.A.

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE

Want better gate valve service?

Cutaway, showing the simple and unique Darling fully revolving double disc gate valve principle that equalizes disc and seat wear, compensates for valve body distortion and provides prolonged tight closing.

IN *your* service Darling gate valves will offer you many times the customary number of operating cycles before repair or replacement is necessary.

It's the unique Darling *fully revolving double disc parallel seat* principle that does it. Get all the facts and see how you save on down-time, part replacement and maintenance.

Darling offers these gate valves in sizes, types and metals for all kinds of normal and unusual services. Write for details, specifying your service requirements.

DARLING VALVE & MANUFACTURING CO.
Williamsport 8, Pa.

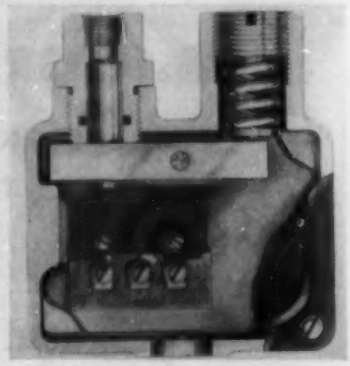
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

More EQUIPMENT NEWS

Begins on page 156

counter, calibrated to record weight of material passing over the conveyor. Full details available in bulletin R-35.

Elliott Co, Roto div, Box 437, Newark, New Jersey

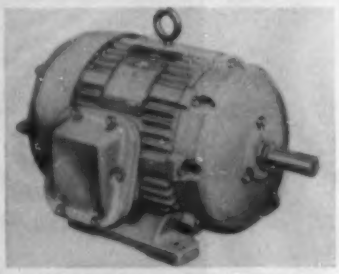


Piston-type pressure switch

828 • Piston-type switches for high speed, automatic, heavy metal working duty, accurately sense any system pressure over an adjustable range of 35 to 12,000 psi with a proof range of 4500 to 20,000 psi. Piston bore and piston are honed and ground to achieve uniform repeat accuracy, according to manufacturer. Generous piston travel prevents undesirable actuation from line surges, jarring or vibration. High proof pressure is protection against damage from excessive line or surge pressures. Unit will actuate an electric circuit at any predetermined point on increasing or decreasing pressure. The fixed actuation value varies from 15 to 1000-psi. Further details on request to manufacturer.

Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.

For more data on these items, use post cards p 165. Identify your request with item number.



Explosion-proof motors

829 • Electric explosion-proof motors are UL approved for use in all Class I, Group D, and Class II, Groups E, F and G hazardous locations. Stocking problems are greatly reduced, manufacturer states, since a single motor can be used for most hazardous locations. Units are available in ratings of 1 to 25 hp, 3 phase, and 1 to 3 hp, single phase. Modifications of the 3-phase motors are also available with UL approval for use in Class I, Group C, hazardous locations. Details on request.

Louis Allis Company, Milwaukee 7, Wisconsin

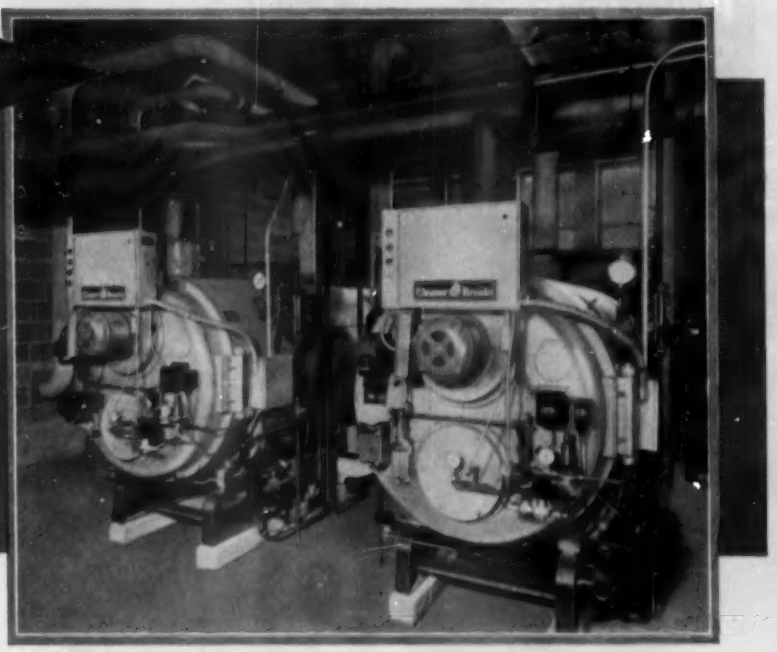
1931

Cleaver-Brooks pioneers big steam capacity in small space

This veteran 20-hp heating boiler — built by Cleaver-Brooks and installed in 1931 — is still in daily use. It is proof of the dependable service you can expect from Cleaver-Brooks' famed four-pass, self-contained boiler construction for any heating or processing need.

1955

Cleaver-Brooks is first again with the ALL NEW "CB" Boiler



- All main burner components are completely integrated for automatic operation.
- More boiler capacity in less space through elimination of extended burner assembly platform.
- Guaranteed 80% efficiency — Four pass construction. 5 sq. ft. of heating surface per bhp.
- 11 sizes — 79 models — 15 to 150 hp, (steam or hot water) for oil, gas or combination oil/gas use. Other models available through 600 hp.
- Complete (Boiler-Burner) unit approval by Underwriters Laboratories — conforms to ASME codes. Factory tested before shipment.

The "CB" is the most easily maintained package boiler on the market. Removal of only nine bolts (on the largest sizes) opens hinged doors for fast inspection, cleaning or service. This convenience has earned widespread praise of insurance firms.

BOILER users will quickly appreciate the surprisingly silent operation of the new forced-draft "CB" — *with the fan mounted inside the front hinged door.* Design avoids use of thin sheet metal housings and usual "chattering" and vibration.

Even greater combustion efficiency is yours with the new "CB" air-atomizing burner, with integral air compressor. All burner components are confined to the front head and the control panel is at operator eye level.

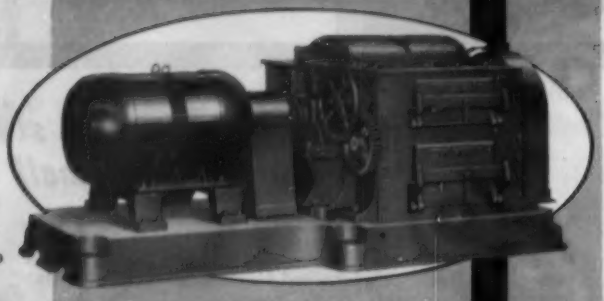
For complete facts on the boiler that's ahead in design, performance and economy, write: Cleaver-Brooks Company, Dept. J, 301 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — All Codes.

Write for copy of latest "CB" Boiler Bulletin covering your size requirements — contains specification data to help you plan.

Cleaver Brooks

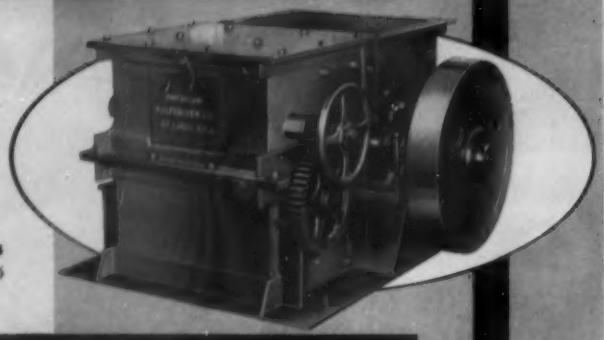
Originators of the self-contained boiler

When You Figure . . .



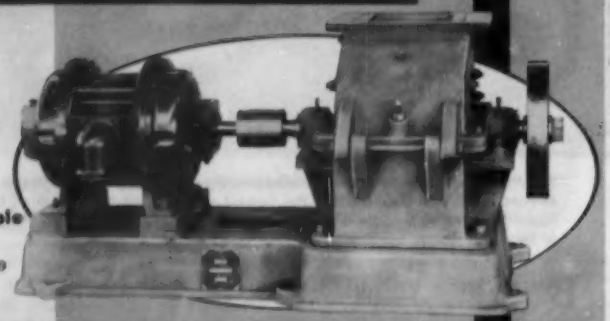
AC Series
capacities to
800 TPH

Reduction
Cost Per Ton . . .



WC Series
capacities to
90 TPH

the Best Answers*. . .



Coal Sample
Crushers
capacities to
2000 Lbs.
Per Hr.

Come from American
Ring Coal Crushers

*In a recent independent survey, it was found that American Crushers reduced over 61,000,000 tons of coal at a parts replacement cost (including standby parts) of *less than 1/10th of 1¢ per ton.*

THERE CAN BE NO BETTER PROOF OF AMERICAN QUALITY!

American
PULVERIZER COMPANY

WRITE for Literature on These Crushers

1349 MACKLIND AVE. • ST. LOUIS 10, MO.

PLAN OPERATIONS

Continued from page 84

rate changes and required changes in combustion air supply.

Steam flow has been added as a load index because the main steam pressure sensing element is close to the high-pressure turbine inlet. A pressure drop here might be caused by closing the boiler-outlet shutoff valve rather than a load change. Steam flow measured downstream from the outlet valve avoids this condition and increases the sensitivity of the master controller to load changes.

Fundamentally, when the load changes, the load master (proportional-plus-reset controller) unbalances a "bridge" circuit formed by the fuel-feed controllers and master so that the fuel-feed controllers must change the fuel-feed rate to rebalance the bridge. Relative response of fuel-feed controllers to bridge unbalance and effect on respective fuel-feed mechanisms are adjustable to accommodate individual characteristics of fuel-feeding devices.

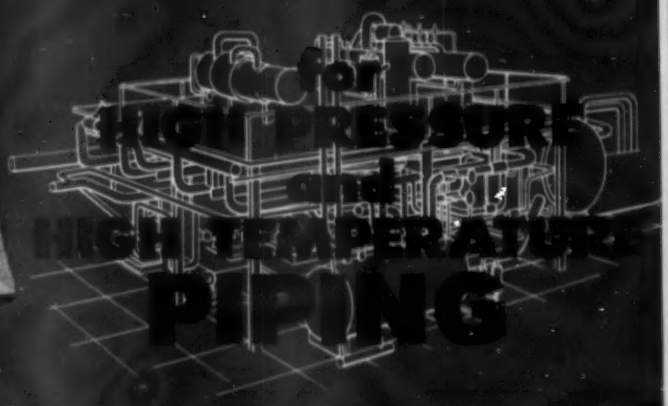
During single-fuel operation all control devices in all fuel-feed lines are continually actuated. As shutoff valves in all but the desired fuel source are closed, only that control is effective. Its fuel-feed control continues to vary the fuel-feed rate on all cyclones until the bridge is balanced.

When burning two fuels simultaneously in one cyclone, manual biasing ing of the fuel-feed controls determines the relative fuel proportions. When buying large blocks of off-peak natural gas it will be burned under manual (base load) control while the coal burns on automatic control and takes the load swings. The relative proportions of fuels burning can be changed without affecting total steam output.

Under manual control, fuel can be fed into any cyclone at up to 200% of maximum full load rating. Overfiring-rate alarms are actuated by totalized measurement of cyclone fuel feed. Cyclones are not particularly sensitive to overfiring, however, and can withstand considerable overload for limited periods.

Protection against deficient air supply at all loads has been included in the combustion-control system. Cyclone load-limit safety controllers preset for slightly richer fuel-air ratios than those demanded by air-supply control operate in parallel with the cyclone air-flow controller units. Should air flow dangerously lag fuel feed, the cyclone's safety controller overrides the control-system impulses and cuts back the fuel feed to the cyclone. If gas-fuel feed cannot be reestablished within safe limits after a reasonable period, the safety controller trips the gas-

STEEL FORGINGS by MESTA



for HIGH PRESSURE and HIGH TEMPERATURE PIPING

custom made to your mechanical and metallurgical specifications

PIPE

TEES

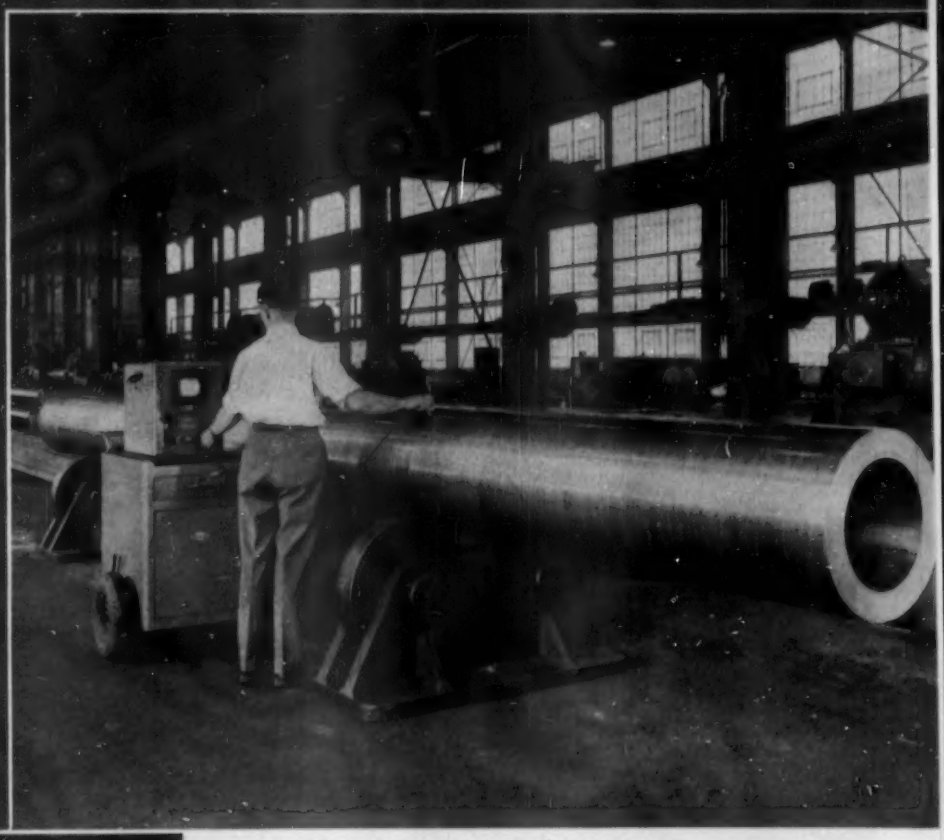
Y'S

VALVE BODIES

LATERALS

CROSSES

ELLS



Ultrasonic Testing with a Reflectoscope is one phase of quality control which provides confident service in High Pressure and High Temperature Piping Systems using Mesta Forged Steel Pipe and Fittings.

MESTA FACILITIES for Forged Steel Piping

Electric Steel and Open Hearth Furnaces
Forging Presses • Heavy Duty Machine Tools
Chemical • Metallurgical • Physical Laboratories
Complete Testing Equipment

Mesta Chrome Molybdenum Alloy Steel Pipe forged, machined, rigidly inspected and tested to comply with customer and code specifications.

ROLLING MILLS • ROLLS • FORGINGS • HEAVY DUTY TOOLS

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Where other packings burned out in 1 week, LATTICE BRAID* continues to give *excellent* service after 3 months operation!

*Registered Trademark. Only Garlock makes LATTICE BRAID rod and shaft packings.

Louis Burk & Company of Philadelphia, makers of bone and dog meal, found that ordinary flax packing would not withstand the temperatures in their *new* steam cookers. Ordinary flax not only burned out in a week's time, but also cut the shafts to as much as 5/16" below normal size. Burk's installed LATTICE BRAID asbestos packing over three months ago. According to Joseph Gray, Master Mechanic at Burk's, it is still giving excellent service.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID *Packings. Contact your Garlock representative or write for new folder AD-131.*

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

PLAN OPERATIONS

Continued from page 180

fuel supply to the affected cyclone.

Variable-speed apron feeders supply coal to each cyclone. When properly adjusted the feeder speed measures coal flow and, roughly, Btu input. This measure is accurate enough to balance required coal feed changes against load changes and set up the initial air flows. Measuring oxygen content of combustion gas leaving individual cyclones acts as a vernier correction on original air-flow setting to fix final air flow.

Determining combustion air need by oxygen analysis compensates for errors in coal-feed measurement and corrects for differences in fuel-heating value during combustion. Fig. 6 shows the slight variation in $\%O_2$ for a wide variety of fuels at given excess air ratios, especially in the 5 to 10% range in which the cyclones run.

When this combustion-control system was being considered (summer, 1953) we had to weigh its advantages against the oxygen-sampling tube-maintenance problem it raised. A completely satisfactory sampling system was not yet developed for cyclones. We were working with Hays on developing a steam-aspirated sampling tube that showed considerable promise. Under these conditions it seemed advisable to provide a secondary-control source.

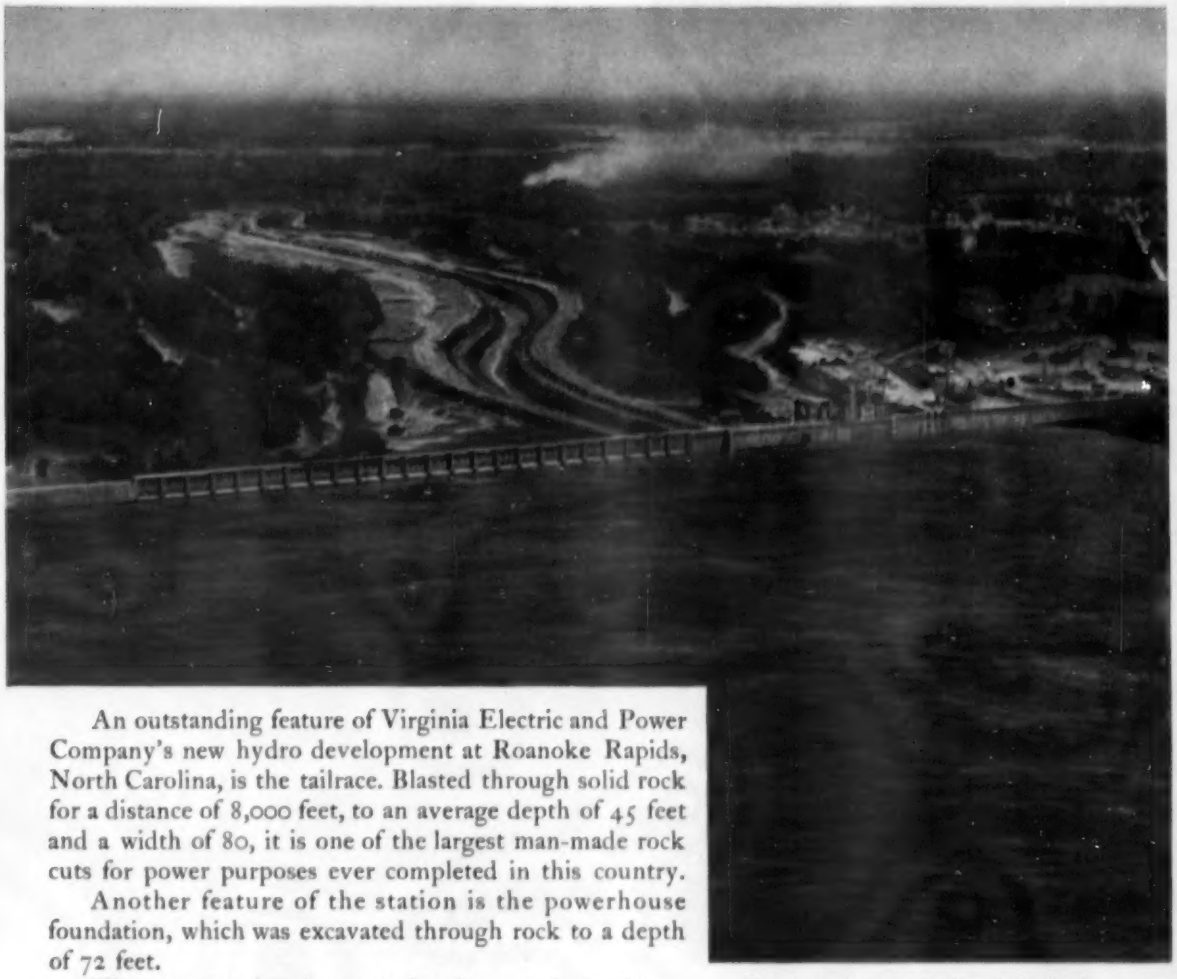
For this reason, air-flow control by conventional steam-flow—air-flow ratio was provided as part of the system and can be used, if needed. It acts as back-up to combustion control by oxygen analysis.

Two 2000-hp f-d blowers supply air to all four cyclones. Each fan is rated at 130,000 cfm at 62.7-in. water static discharge pressure and 105 F. After leaving the common discharge plenum at the air-preheater exit (700 F) the air enters four main ducts, one for each cyclone, Fig. 7. Each 84-in.-dia duct has a venturi section as the primary element measuring air flow to the cyclone.

Fan discharge pressure and system resistance to the stack exit determine the air quantity delivered by the fans. These two factors, in turn, are principally determined by the relative opening of the fan inlet vanes and the position of the secondary air damper, and to a lesser extent by the positions of the main and reheat gas-pass dampers. When a cyclone's individual fuel-air ratio controller (which is constantly comparing metered fuel input to metered air flow) calls for more air, the secondary air damper for that cyclone starts to open. This lowers the system resistance and static air pressure and increases air flow. But the boiler manufacturer recommends that the over-all

(*Continued on page* 186)

MAN-MADE ROCK CHANNEL FOR MORE KILOWATTS



An outstanding feature of Virginia Electric and Power Company's new hydro development at Roanoke Rapids, North Carolina, is the tailrace. Blasted through solid rock for a distance of 8,000 feet, to an average depth of 45 feet and a width of 80, it is one of the largest man-made rock cuts for power purposes ever completed in this country.

Another feature of the station is the powerhouse foundation, which was excavated through rock to a depth of 72 feet.

The concrete dam is 3,050 feet long, and provides a maximum net head of 81 feet.

Four adjustable blade propeller type turbines in the semi-outdoor powerhouse add 100,000 kilowatts to the VEPCO system.

View from above dam at Roanoke Rapids Power Station. The project, which will serve the fast-growing Virginia-North Carolina industrial area, requires a reservoir nearly 9 miles long, with a surface of 4,900 acres. Construction was by Stone & Webster Engineering Corporation.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

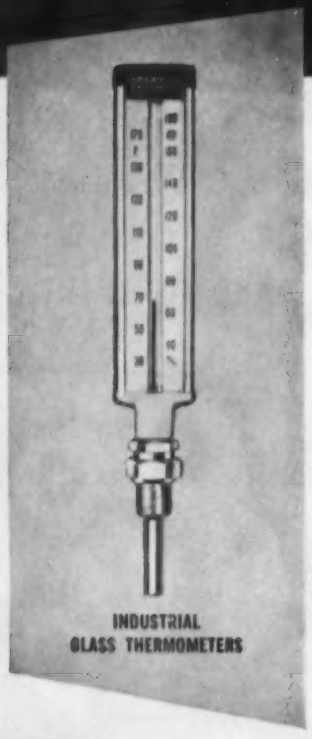
A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago San Francisco Los Angeles Houston Pittsburgh Seattle Toronto

DIAL THERMOMETERS

RECORDING THERMOMETERS

GET SERVICE-PROVED ECONOMY



INDUSTRIAL GLASS THERMOMETERS

SPECIFY

AMERICAN THERMOMETERS!

Is exact temperature measurement essential to safeguard your equipment? To assure uninterrupted service to customers? To maintain product quality? To control costs? Then American Thermometers belong in your plant! They are an unbeatable combination of highest quality materials, advanced design, rugged construction and precision manufacture. Their sustained accuracy protects processes, products and profits. Their long-life durability has been proved in outstanding performance in the severest services.

Whether you need industrial glass thermometers, dial types, or recorders, the complete American line provides for practically every application. Depending on instrument type and requirements, temperature ranges available are: minus 80° F. to plus 1150° F. Types of actuation include: mercury, vapor pressure, gas and bi-metal.

FOR EXPERIENCED COUNSEL, prompt delivery from local stocks, and greatest economy, buy through your Industrial Supply Distributor. Catalog sent on request.

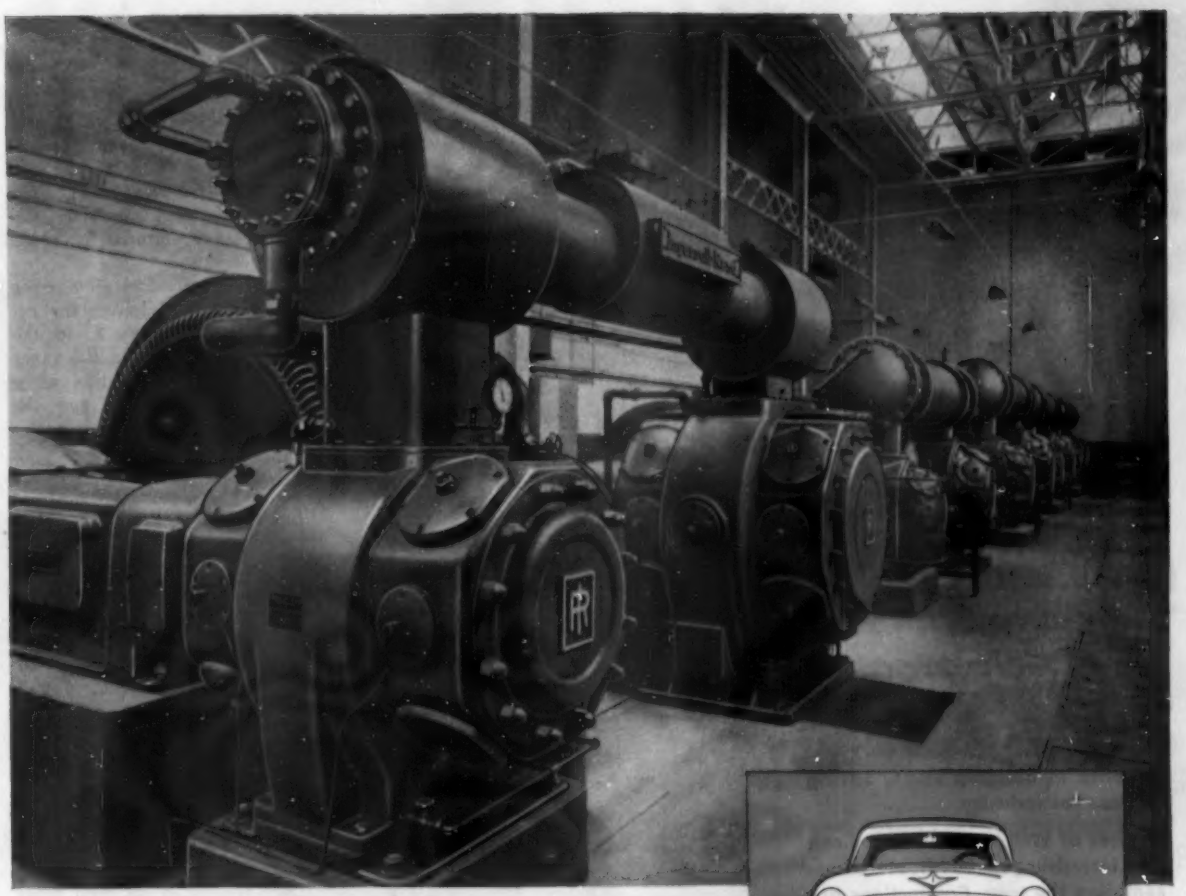
1858 AMERICAN U S A

AMERICAN INDUSTRIAL INSTRUMENTS

MAXWELL MANNING MM&M

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, *Stratford, Conn.* HANCOCK VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



Streamlined Air Power Plant

behind the streamlined NEW HUDSON

Modernized compressor room at Hudson Division of American Motors simplifies operation and maintenance

AT Hudson, improvement of plant and product go hand-in-hand.

Here, the compressed air plant previously consisted of one steam- and four electric-driven compressors, in three different locations. The old steam-driven unit, which had out-lived its value as a dependable standby, was replaced by a new Ingersoll-Rand 3,000 cfm PRE compressor. All five electric-driven compressors were then installed in a single building, with receivers and aftercoolers in the basement directly below. This compact installation is shown above, with the new PRE unit in the foreground. The four other compressors are also Ingersoll-Rand PRE units. Although more than 25 years old, they were found to be in such excellent running condition throughout that there was no need for replacement.

Wherever you need thoroughly dependable, low-cost air power, it pays to specify Ingersoll-Rand. Your I-R representative will be glad to show you why—and give you full details on any type of air or gas compressor. Helping you is his business!

Ingersoll-Rand

1-260 11 Broadway, New York 4, N. Y.

COMPRESSORS • CONDENSERS • AIR & ELECTRIC TOOLS • PUMPS • ROCK DRILLS • GAS & DIESEL ENGINES

Reliability

DESIGNS THAT REPRESENT 50 YEARS TRAP BUILDING EXPERIENCE

"airxpel"

STEAM TRAPS

Remove Both Air and Condensate

"CUB" TYPE
½" to 1½"
to 250 PSIG

"MASTER" TYPE
½" to 2"
to 300 PSIG

"Y" STRAINERS
2" to 8" (flanged)
½" to 3" (threaded)

FORGED STEEL
½" to 1¼"
to 600 PSIG

This equipment offers design advantages that represent long experience in building steam saving devices for industry.

Orifices of Wright-Austin traps can be interchanged without disassembling the trap. Connections are the straight-through type. Both of these features contribute to speed and ease of installation.

Wright-Austin traps are available for lines ½" to 3", for pressures up to 600 P.S.I.G. and with capacities up to 65,025 pounds of water per hour.

For complete information on traps and other accessories that you can stock to advantage and depend on for efficiency that means low cost, write, today, for:

Trap Catalog #600
Separator Catalog #500
Boiler Trim Catalog #700

WA Standard STEAM TRAPS SINCE '94

WRIGHT-AUSTIN
COMPANY
3245 WIGHT STREET • DETROIT 7, MICH.

PLAN OPERATIONS

Continued from page 182

differential pressure between the upstream and of the main air duct and the primary furnace be maintained at about 35 in. water to carry the coal into the cyclone from the rotary seal. This insures a suitable cyclonic vortex air-distribution pattern essential to proper fuel-air mixing.

If opening the secondary air damper increases air flow and lowers the cyclone air differential below 35 in. the f-d inlet vane controls open the vanes enough to place fan operation on a higher head-capacity curve and the secondary air dampers adjust to maintain air flow constant at the new level. Fig. 8 shows the interaction of secondary air dampers and inlet vanes of the f-d blowers.

The balancing relay in Fig. 5 compensates for differing characteristics of the two f-d blowers and makes them each carry a proper share of the load.

Part 2 of this article discusses other control systems in the Raritan River Plant—in a forthcoming issue.

ATOMIC REACTOR

Continued from page 96

flux entering the fluid simply measured as Q/A, Btu per hr per sq ft of surface.

2. Surface tension of the fluid being boiled. Surface tension measures the ability of the fluid to wet the heated surface. Wettability depends on the adhesive forces between the fluid molecules and heated surface as compared to the cohesive forces between the fluid molecules.

3. Smoothness and cleanliness of the heat transfer surface.

4. Temperature difference between the heated surface and saturation temperature of the boiling liquid.

5. Position of heat-transfer surface —horizontal, vertical or inclined.

6. Thermal conductivity of liquid and vapor.

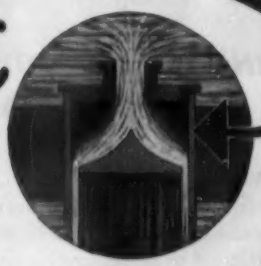
Fig. 5 shows the effect of surface tension of the boiling liquid in forming vapor bubbles. A low surface-tension liquid readily wets the hot surface and easily surrounds the vapor bubble so that it floats off the surface to rise through the liquid.

In a medium surface-tension liquid, the cohesive forces between liquid molecules, and adhesive forces between liquid and surface, are about equal. The vapor must form a larger bubble before it can break away from the surface and float up through the liquid.

In high surface-tension liquids the liquid-molecule forces are so large that the liquid has trouble trying to sur-

Dirty Water can't "Shut-down"...

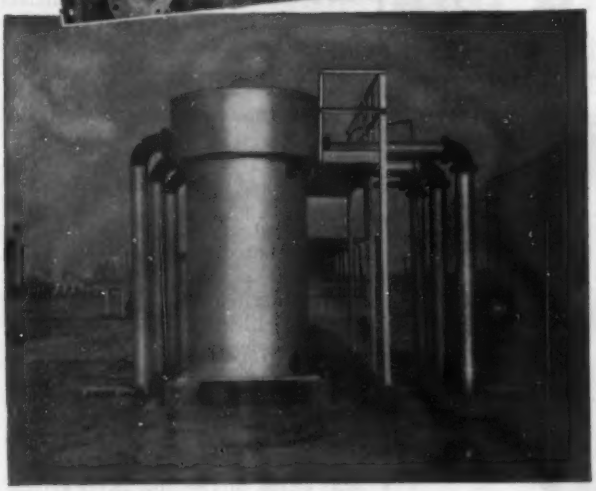
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,500 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

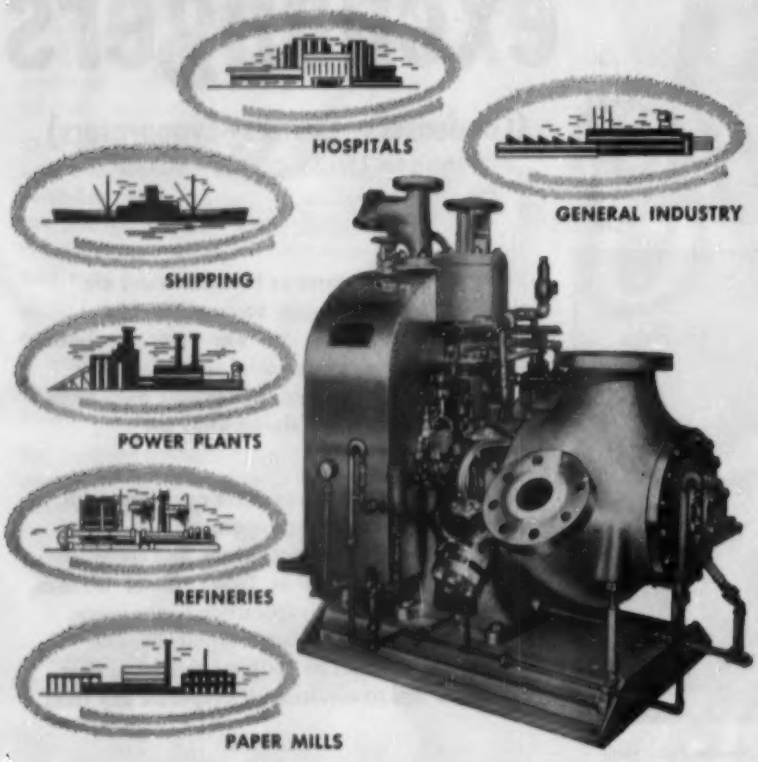
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

VERSATILITY!

ENGINEERED FOR OUTSTANDING PERFORMANCE IN MANY OPERATIONS!

On board ship, in refineries, hospitals, public utilities—in paper, textile and all general industry, the Coffin line of turbo equipment is earning nation-wide acceptance for outstanding performance. Designed with versatility in mind, latest addition to the line the Coffin "DE" Turbo Pump has a Volumetric Range to 800 GPM, Discharge Pressures to 1500 psi, Steam Temperatures to 850° F., Exhaust Pressures to 80 psig, and Liquid Temperatures to 325° F. Ratings can be exceeded in special installations.

Engineers! Write today for complete specifications. Ask for "DE" Bulletin G-110.



THE J. S. COFFIN, JR. COMPANY
126 South Dean Street, Englewood, New Jersey
Cable Address: COFCO
Representatives in the United States, Canada, Europe, and the Far East

ATOMIC REACTOR

Continued from page 186

round the vapor and lift it off the hot surface. This causes vapor blanketing of the surface or film boiling.

To maintain high heat flux the metal surface should have a good finish and be free of scale. The latter depends on the liquid, which should be free of scale-forming impurities.

Most liquids can boil by either the nucleate or the film process. These depend on both the heat flux and the temperature difference. Fig. 8 shows the relation for water, at atmospheric pressure and at 2400 psi. As we raise the temperature difference from 1 to 10 F the water is being preheated at increasing heat fluxes through the heat-transfer surface. This heat distributes through the water by conduction, aided by natural convection currents.

Between 10 and 50 F difference, nucleate boiling takes place. At the lower end of this range we have both nucleate boiling and superheating of the liquid with lower heat fluxes. At the higher end we have only boiling, and the heat flux reaches a maximum called the *critical point* or *burnout* heat flux.

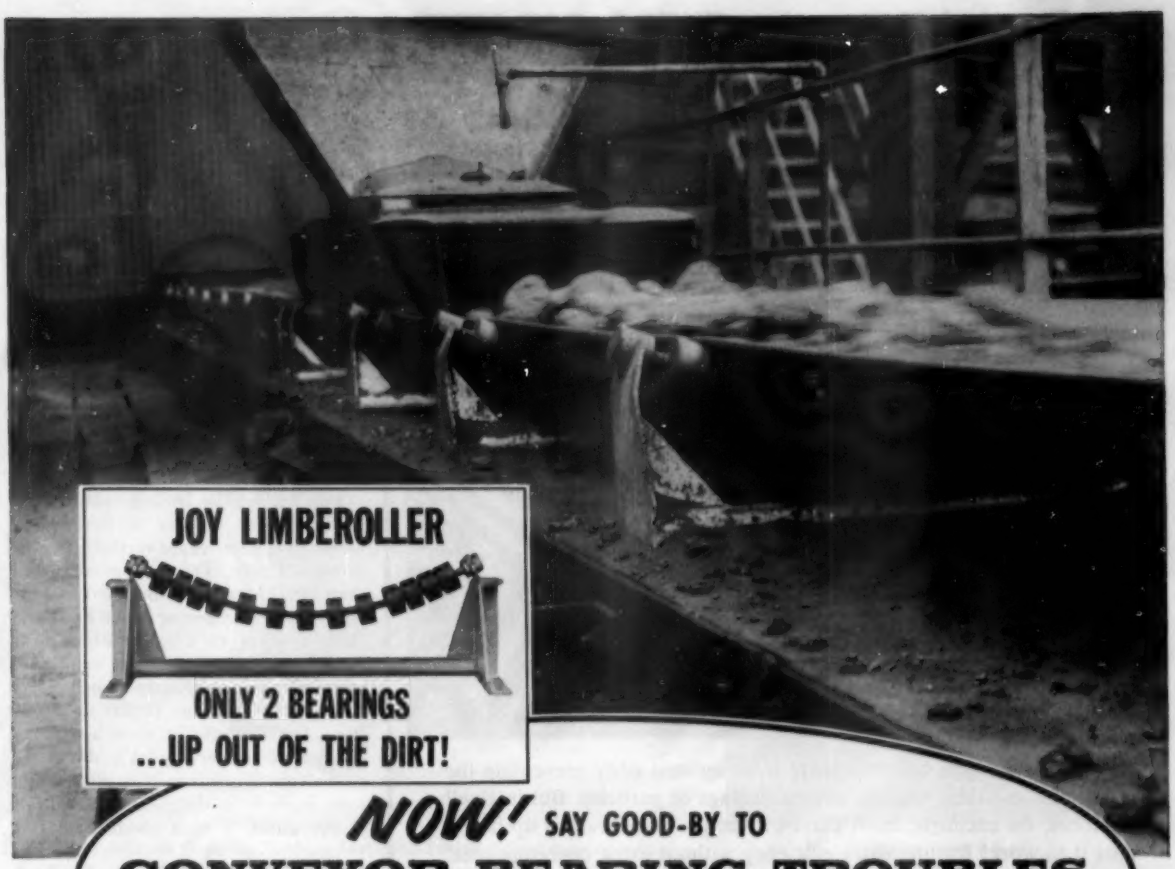
If the heat-transfer-surface material can stand the higher temperature, we can push the temperature difference above 50 F. Doing this causes the heat flux to drop because we enter a region where a combination of nucleate boiling and film boiling comes into play. Above 100 F the heat flux reaches a minimum where film boiling takes over completely. In this range the heat flux drops because of lower conductivity of the steam film covering the heating surface.

As we continue raising the temperature difference, radiation from the heat-transfer surface to the liquid comes into play and the heat flux again rises. Eventually the surface becomes so hot it melts and fails.

Circulation. Boiling-water reactors with water and steam flowing in parallel tubes have circulation problems similar to fuel-fired boilers. Fig. 6 shows three tubes receiving different heat fluxes but connected across common manifolds with a pressure difference ΔP. The tube *A* receiving the greatest amount of heat produces steam more quickly, so it has the least water and most steam in its length. But because of the greater specific volume of steam this tube has the least lb-per-hr flow.

The poorer conductance of the steam film allows the upper tube-wall temperature to rise. At the upper end of the tube we eventually will have a burnout. Tube *C* with the lowest heat flux will run the coolest and produce the least steam—indeed, it could carry water up into the discharge manifold.

This is an unbalanced condition caus-



NOW! SAY GOOD-BY TO CONVEYOR BEARING TROUBLES and DELAYS

CAUSED BY DUST AND GRIT FROM ASHES AND COAL

The Joy Limberoller idler consists of neoprene discs molded on neoprene-covered flexible steel cable. It is suspended from two bearings, one on each end, *out of the dirt zone.* This distinctive design, field-proved by thousands of idlers already in service, averts fouled idler rolls—protects the belt from damage—reduces your maintenance to a fraction—*gives many times longer service life on dusty, gritty or corrosive jobs.*

OTHER ADVANTAGES, TOO . . . Joy idlers are self-training—they conform to the load with a cushioned grip which supports the loaded belt without slipping and reduces belt wear. They resist corrosion, abrasion, flame and grease—weigh ⅔ less than steel idlers, and handle bulk or packaged materials equally well. They're easily changed *without stopping the belt,* and compactly stored.

Whatever your belt conveyor job may be, let us help you to make it more efficient and economical. Joy Limberoller Idlers are available for belt widths of 18", 24", 30" and 36". You'll find them easier, faster and less costly to install, maintain, knock down and move than any other conveyor idler on the market. ● For more information, write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Ltd., Galt, Ont.*

WRITE FOR COMPLETE DETAILS

Ask for free *Bulletin LD-103*

It gives complete information on the unique Limberoller Idler, and we'll be glad to supplement it with engineering assistance on your particular problem.

Consult a Joy Engineer

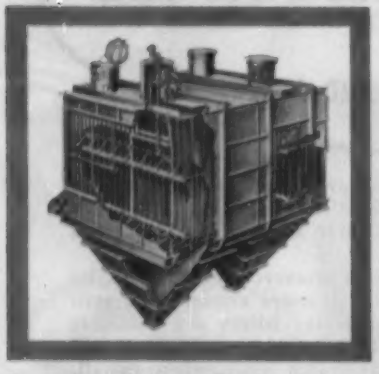
W&D 6706-E

JOY

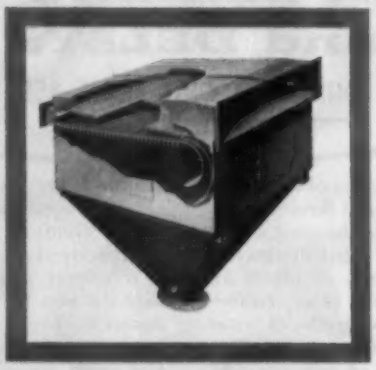
SINCE 1851—OVER A 100 YEARS OF ENGINEERING LEADERSHIP

How Buell delivers the EXTRA PERCENT in Dust Collection Efficiency

In any cyclone dust collector there is an upward eddy preventing the separation and dropping-out of a percentage of particles. But in Buell Cyclones, the exclusive Buell shave-off design *harnesses* this up-flow—puts it to work! Result: extra efficiency without extra operating cost!



Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or forced draft installations.



SF Electric Precipitator, a Buell exclusive, also delivers *extra efficiency* due to unique Spiralectrodes and continuous cycle rapping.

For the complete story behind Buell's *extra efficiency*, write Dept 50-H, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

buell

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

ATOMIC REACTOR

Continued from page 188

ing tube burnout and possibly excessively wet steam. To correct this condition we must first recognize that ΔP stays constant and we must force more flow into the tubes receiving the greater amount of heat. This can be done by inserting orifices into tubes *B* and *C* having excessive flows, Fig. 6, right.

Layout of the heating surface in a natural-circulation system has some effect on boiling-heat-transfer conductance because of convection effects. In a forced-circulation system, though, this may not be important. A reactor plant must be properly designed to carry off decay heat energy by natural circulation in a complete pumping failure.

Fig. 7 gives the boiling heat-transfer coefficient for various proportions of vapor in a water-vapor mixture flowing through a tube. For vapor content less than 70%, h varies from about 6000 to 8000 Btu per hr per sq ft per F. Above 70% it drops to a range of 1000 to 2000 Btu. Under laboratory conditions of a clean heat-transfer surface, h might be as high as 10,000 to 20,000 Btu. Any deposits or scale accumulation on the surface quickly drops the coefficient. While exact coefficient for scale depends on the chemical condition of the water, it runs about 2000 Btu.

References. *Liquid-Metals Hanbook*, Atomic Energy Commission, Department of the Navy, June 1952.
Foundation of Modern Physics, Brown.
Thermodynamics, H A Everett, D Van Nostrand.

Next article will discuss reactor materials, in a forthcoming issue.

DIESEL FUEL EQUIPMENT

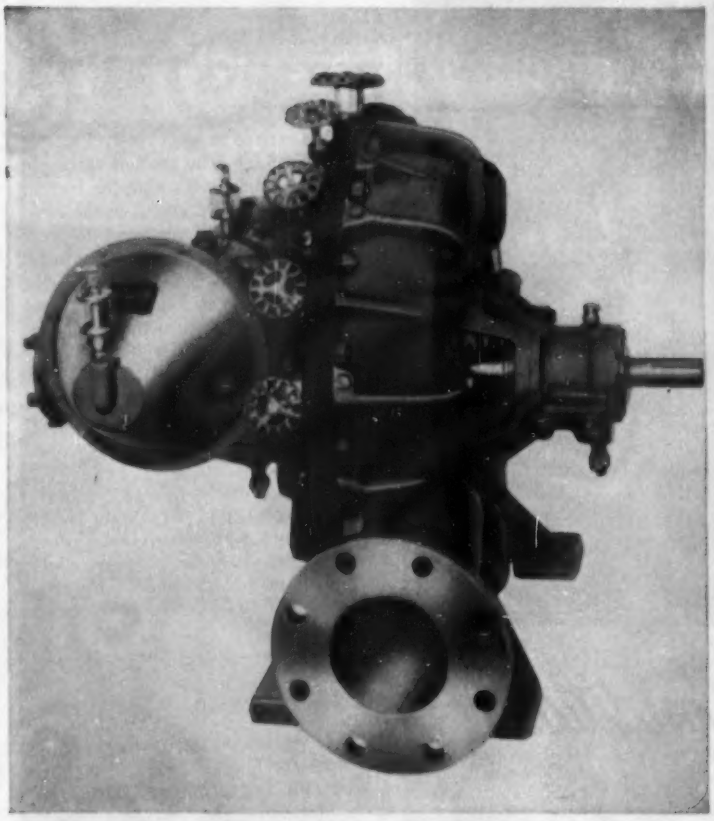
Continued from page 115

zle valve, broken pintle also can cause trouble.

Some nozzles have a leak-off connection that returns surplus fuel oil to a pump or tank after it lubricates the injector's moving parts. If leak-off is greater than normal, you may have (1) loose nozzle cap (2) too much clearance between valve and valve body (3) damage to lapped joints of body or holder.

A nozzle may turn blue, like gun metal. Blame this on (1) failure to clean nozzle recess of scale and rust (2) use of gasket between injector and recess, stopping heat transfer (3) using wrong type of nozzle for the engine. You can dump blued injectors.

A good injector placed on the test stand will tell you that it is ready for service. It "chatters"—a short, snappy efficient sound.



This is the reliable Coppus Turbine furnished with either type of wheel

Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
168 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Each Kel-F lined rupture disc is given a leak detector test and must be proven pin-hole free.

The large stock of controlled ductile metals used in the manufacture of BS&B rupture discs enables us to duplicate a previous requirement as well as affording you a wide selection in pressures — from 3 to 50,000 lbs.

For CORROSIVE Conditions

Equip Your SAFETY HEADS With BS&B Kel-F Lined Rupture Discs!

Whenever BS&B Safety Heads are installed in a location where corrosive conditions exist, an unprotected metal rupture disc may be vulnerable to corrosive attack from either the product or the atmospheric side—or both.

The recommended disc to use under these circumstances is the BS&B Kel-F lined rupture disc, which has for more than 3 years proven its resistance to corrosive attack from strong acids, caustics, chlorine, etc. Kel-F is a trade name for a thermo-plastic film of trifluorochlorethylene, which is also known by the trade name of Trithene. Discs may be specified with the Kel-F lining on either or both sides, as your conditions may require.

The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel and nickel means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a *better* safety device for the protection of closed pressure systems!

For full information on the BS&B Kel-F lined rupture disc and its application to your specific problem, consult your BS&B Office or Representative . . . or write to us direct.

THE "CIRCUIT-BREAKER" OF ***Any Pressured System***

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-Q8
7500 East 12th St., Kansas City 26, Mo.

EFFICIENCY 1/10 of 1% BS&B RELIABILITY

ARGUMENTS

Continued from page 138

Boiler explosion *continued*

wand and started to open the fuel valve, lighter gas on fringe of the concentrated gas ignited quickly. Burning the fringe permitted oxygen remaining in the furnace to move into the center of the gas concentration; the explosion resulted.

Coal gas accumulations in stoker-fired boilers have also caused furnace explosions. Such explosions all occur during those hours when humidity of the night lessens, around 7 am.

In automatic operation of gas- or oil-fired boilers, the boiler itself becomes a closed box, as air inlet under the fire is closed.

Installing *draftstats,* or other balanced swinging type breeching dampers that open when the furnace pressure is reduced could possibly eliminate much of this trouble. Then warm air could pass into the breeching and up the stack.

J M Gorrie *Euclid, Ohio*

Tall stack *continued*

rise (2) increased pressure, as furnished by the fan.

When the fire is started, warm gas rises and fills the enclosed space around the boiler tubes. Fan pushes it out through the breeching into the stack, where it rises because of its greater buoyancy. Draft up the stack starts in the natural sequence of events.

I suspect there was a draft up the stack that Marmaduke mentions, even before fire was lit or fan started.

In this area, burning oil or gas, fireroom regulations require running fans a specified number of minutes before lighting off. Neglecting to purge furnace and stack of explosive gas has caused wrecked boilers and loss of life.

So any time a draft cannot be started, I look for an obstruction between the furnace and the stack.

H T Livingston
Los Angeles, Calif.

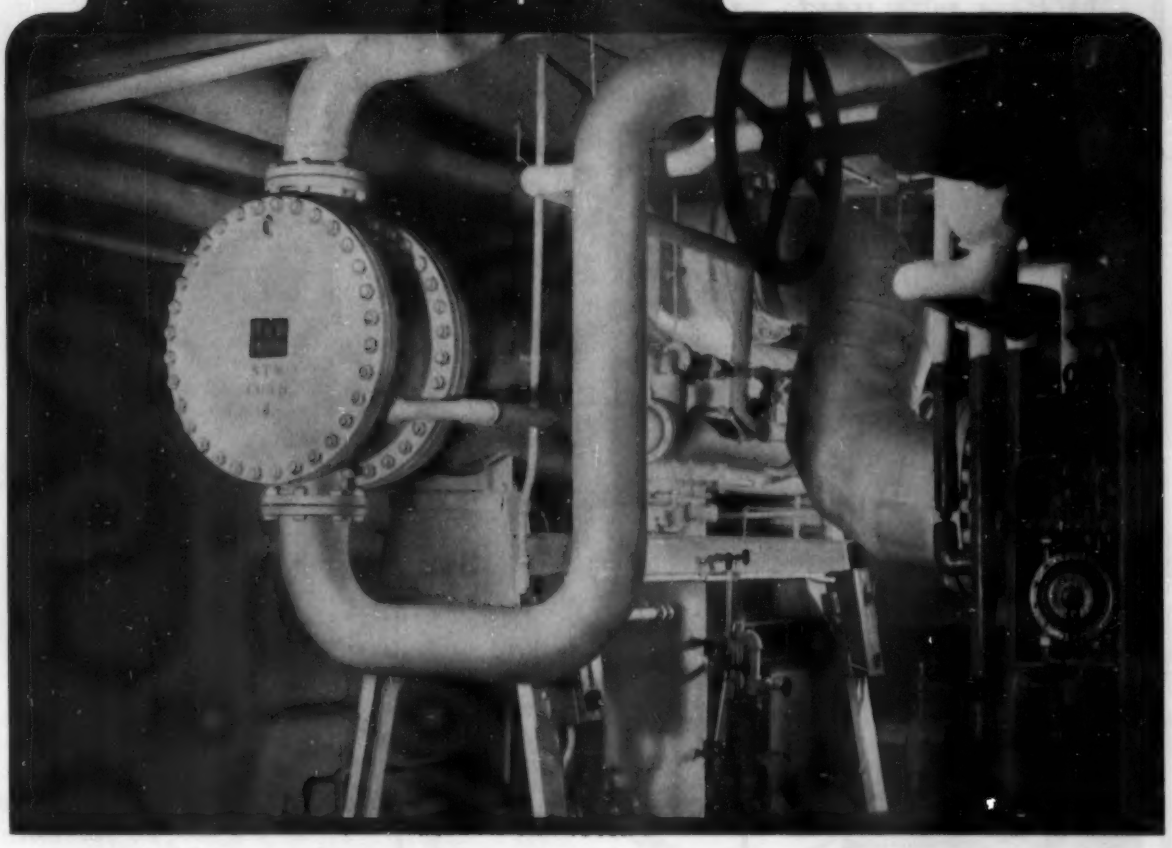
MARMADUKE

Continued from page 144

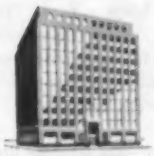
we greased the machinery. Then I packed my bag and headed for the freight yards. I found a train ready to shove off for the Southwest. Next to a boxcar was a flatcar loaded with four large blowers. The consignment tag said she was headed for an oil refinery in Texas, so I climbed aboard.

"Keeping hidden from the railroad bulls was my big job, but I made it all the way to Texas. One morning a week later I awoke on a siding next to a new

Here's a K-R Report . . .



on the Dun & Bradstreet Building's Surface Condenser Installation



Condensing exhaust steam from a 585 hp Worthington turbine which drives a centrifugal refrigeration compressor, this Ross Surface Condenser is an important component of the air conditioning system in the new Dun & Bradstreet Building, New York City. There are two of these Ross units in service.

Dun & Bradstreet, Inc. is another important name in the long list of renowned companies which the Kewanee-Ross organization is privileged to serve. Everywhere, in industries and public utility power plants throughout the world, Ross Surface Condensers rate high . . . *and have for years!*

Long a leader in the surface condenser field and famous for its many noteworthy design improvements, Kewanee-Ross is today in the best position of its history to meet your requirements. With recently expanded manufacturing facilities . . . with two large plants to serve you now . . . Kewanee-Ross is ready to engineer, fabricate and deliver *exactly* what you need in surface condensers.

You will be impressed with the facts and figures that will come out of a brief consultation with a Kewanee-Ross engineer. Arrange a date, *at your convenience,* soon.

ROSS

SURFACE CONDENSERS

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

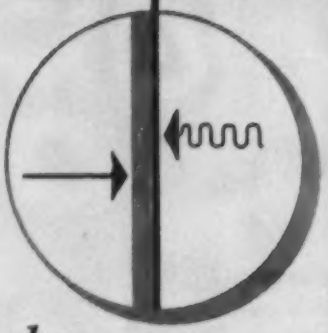
1415 WEST AVENUE • BUFFALO 13, N. Y.

In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL

Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

MARMADUKE

Continued from page 192

boilerhouse at the edge of a large refinery. After washing up at a roadhouse near the plant, I sat down to my first square meal since signing off my ship. Then I navigated back to the boilerhouse for a look-see.

"The contractor's foreman was running a little behind schedule so he put me to work. As luck would have it, my first job was helping unload my old shipmates, the blowers. Then we started setting them up on their new foundations. Soon as they were leveled and bolted down, I noticed they had double-row ball bearings. That would have been OK, but in this case it was bad news for the contractor because he was already running behind time.

" 'You won't start your blowers on schedule,' I told the foreman, who was a construction man and didn't know very much about ball bearings.

" 'Says you,' he said, giving me a fishy look, 'And what makes you think I won't?'

" 'Because I've got a hunch they'll rattle to beat hell,' I answered. But I could see he didn't want advice.

" 'Look mister, suppose you let me handle this job and you do only what you're told around here. OK?' he shot back.

" 'OK,' I answered, 'But if you don't listen to me before you get your electric motors next week, you won't start this plant on forced draft on time.'

"That was like waving a red flag before a bull. 'What makes you think those blowers aren't right?' he asked, getting ready to blow a fuse. 'They're the latest design, they're brand new and straight from the factory. Why you keep harping on them? Ya think I never worked with blowers before?'

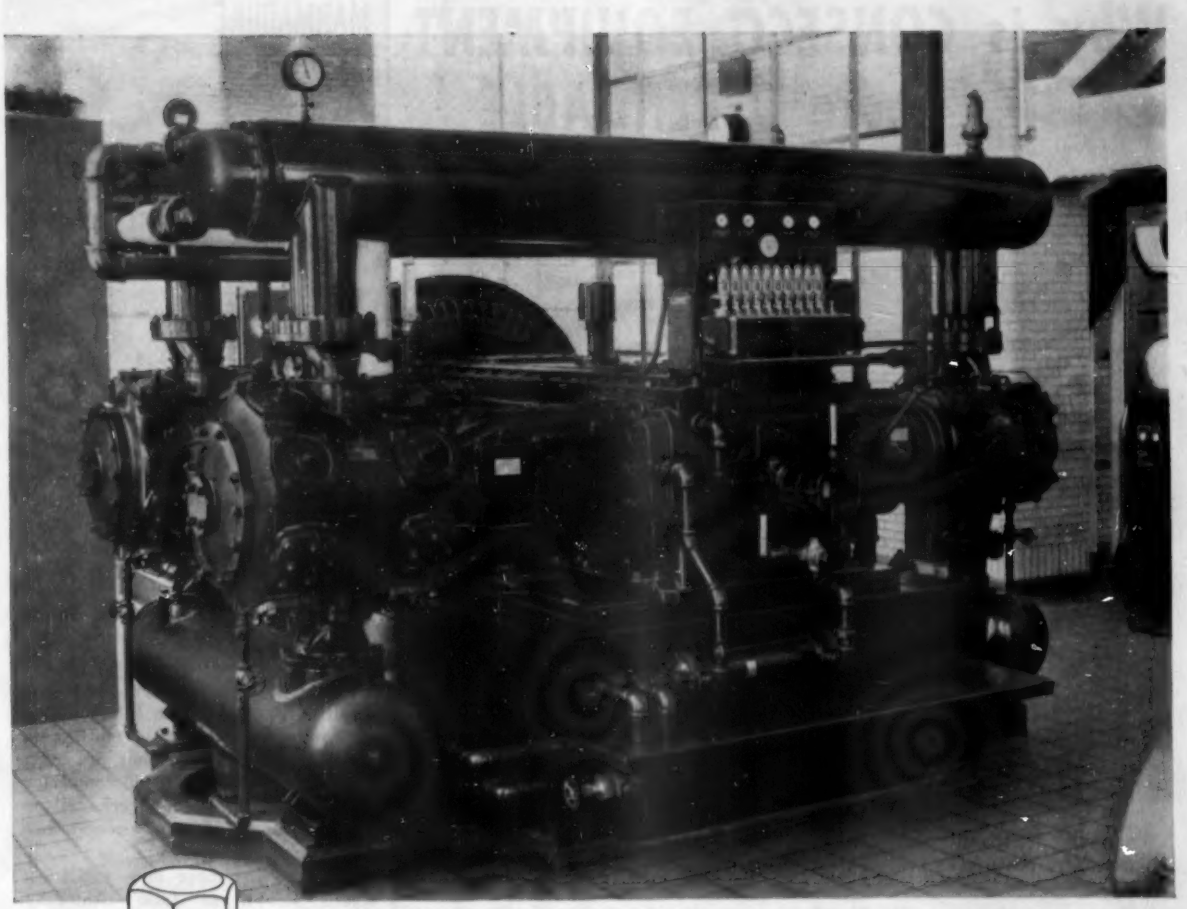
"Because of his attitude I didn't bother to tell him—I'd let him find out the hard way. He didn't know I rode down on the same train with his blowers. The other men heard the argument and gathered around.

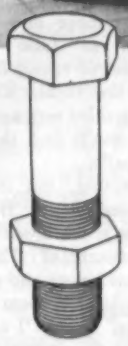
" 'I know blowers and I want you to be in a position to live up to your contract,' I told him quietly. Again, that was the wrong thing to say. He blew a gasket this time and told me to get my money.

" 'OK,' I said, 'I'm staying at the Railroad Hotel. I'll hang around until you need me. But you'll pay a bonus if you want me to show up.' With that blast I shoved off.

"Sure enough, when those blowers were hooked up to their drives and started, they rattled so badly they had to be shut down. The foreman had the fans taken out and tested for balance.

(*Continued on page* 196)





JUST BOLT IT TO THE FLOOR

that's all Ford had to do

Expanding operations at Ford Motor Company's assembly plant in Buffalo, N. Y. demanded additional shop air capacity. It had to be installed quickly and, if possible, without disruption to existing facilities.

Inasmuch as the installation was to be on the second floor of the power house, Ford engineers selected a Clark CMA-4, 350 horsepower, Balanced/Opposed Compressor. The low installation cost was an important factor.

With the Clark motor-driven unit, it was unnecessary to run foundations all the way down to the basement. Piping, which was beneath the proposed compressor location, did not have to be moved.

Because of the perfect balance of the Clark unit, it was possible to mount the motor and compressor on a steel sub-base which was bolted to floor I-beams. No foundations were required. No pipes were relocated.

. . . nor was there any lost production. The Clark unit was tied in over a weekend.

The Buffalo assembly plant is but one of many Clark Compressor installations serving the Ford Motor Company's vast operations.

Before you consider any proposed compressor location *impossible*, it may save you money to talk it over with your nearest Clark representative. In the meanwhile, make sure you have Bulletin 118 in your files. Write today.

CLARK BROS. CO. • OLEAN, N. Y.

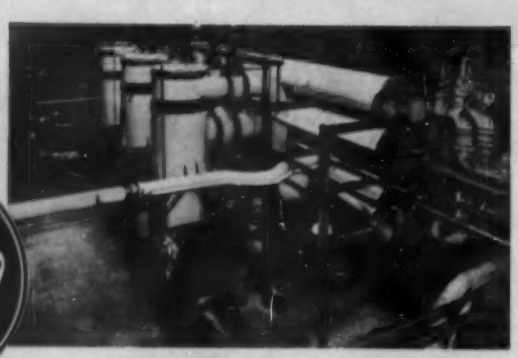
One of The Dresser Industries

Sales Offices in Principal Cities Throughout the World

PRECISION BY THE TON **CLARK** **balanced/opposed compressors**

150-4500 HP

Why is CONSECO EQUIPMENT more DEPENDABLE and ECONOMICAL?



Three vertical type, full floating head Conseco Hot Water Converters.

Yes why?

CONSECO DESIGN forestalls troubles

We know the trouble spots of practically every make of heat exchanger, condenser, evaporator, pressure vessel, and similar equipment on the market. Why?—because our maintenance division has been repairing, rebuilding, and modernizing equipment made by various manufacturers for many years.

Conseco engineers profit by the experience of our maintenance division in the design of Conseco equipment. They literally "engineer out" troubles. Thus you are assured of maximum operating efficiency and lowest maintenance cost.

Tell us the type of equipment you need, and we'll send you informative bulletins.

CONDENSER SERVICE & ENGINEERING CO., INC.

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 Observer Highway
Hoboken, N. J.

EQUIPMENT DESIGNED AND BUILT BY CONSECO

Conseco and its subsidiaries design, build, and install power and processing equipment and accessories, some of which are listed here. Purchasers of Conseco equipment benefit from our maintenance division's quarter century experience in rebuilding, modernizing, and maintaining our own as well as competitors' equipment. This coordination assures easy accessibility for maintenance and low operating cost. Send for bulletins covering equipment in which you are interested.

HEAT EXCHANGERS
CONDENSERS
EVAPORATORS
STEAM JET AIR EJECTORS
STEAM GENERATORS
PRESSURE VESSELS
CENTRIFUGES
FILTERS and STRAINERS
PUMPS, INSTRUMENTS, SPECIALTIES

MARMADUKE

Continued from page 194

When they were again assembled and started, they were noisy as before.

"The contractor found out about me warning his foreman. He was pressed for time and didn't care to lose money, so he drove down to my hotel. After a little talk I went back to the plant with him. By now the boys had taken sides. Some thought I was screwy, while others thought the foreman was off his rocker for not listening to me. They gathered around to see what I'd do. The foreman was there—boiling.

" 'First you can make out a check for $200,' I told the boss. 'Then I'll show you how to have those blowers ready to roll by tomorrow noon. That's only a few hours later than your contract calls for.'

"This time the boss blew a gasket, but he saw I had him up a tree—and his erecting mechanics couldn't offer him any way out of his trouble. He made out the check.

" 'OK,' I told him, 'Your trouble is bearings, not balance. Just wire to Boston for new bearings. Have them flown down so you have them first thing tomorrow. Then replace the ones in the blowers and your problems are over.'

" 'Not so fast,' yelled the contractor. 'Before I hand you this check, tell me what's wrong with the present ball bearings.'

" 'If you'll remove one, you'll see what's known as false Brinelling. You'll find a set of round dents or indentations in the races. They should be only about a third way around at the bottom. And you'll find them spaced same as the balls.

" 'Wait a minute,' cut in the foreman, getting suspicious. 'How in hell do *you* know so much about what we'll find in those bearings? They haven't been taken apart before and you weren't here when we started them up.

" 'That's easy,' I said. 'I noticed that the railroad car they were shipped on had a flat wheel. That's what I tried to tell you last week, but you wouldn't give me a chance to explain. Those cavity formations are from the impact load put on races by the weight of the fan-and-shaft assembly every time that flat spot hit the rail. So the impact load deformed the races at the points of ball contact, same as a piece of hard steel is deformed in a Brinell test.'

"By then two hammer-and-chisel mechanics had one of the bearings off a blower and had taken it apart. And sure enough, there were the dents, exactly as I said they would be.

"While the boss looked at them and scratched his head, I reached for the check and put it in my pocket.

" 'Now I'll tell you what to do,' I told

County Courthouse, Newkirk, Oklahoma

Where does the Court get its power?

For seven years in Newkirk, Oklahoma, one powerful machine controlled the power of the court... a Fulton 800 H.P. dual-fuel generating unit, lubricated by Cities Service Pacemaker #5 Oil.

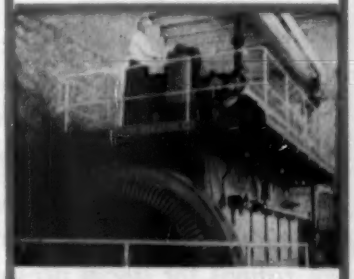
But it wasn't only the court that depended upon this one machine . . . the entire town relied upon it. If the machine failed, so might the annual grain harvest, for Newkirk's grain elevators require great quantities of power.

BUT THE FULTON GENERATING UNIT AND CITIES SERVICE LUBRICATION PROVIDED FAULTLESS SERVICE. There was never a breakdown.

Newkirk's power boss, Superintendent of Utilities Ralph E. Cottrell, sums it up this way: "Using Pacemaker #5 in the engine's crankcase and cylinder lubricators, we not only enjoyed trouble-free operation during those seven years, but also surprisingly little wear and oil consumption. Rings, bearings and liners remained in top notch condition and the engine piled up well in excess of 6000 horsepower hours per gallon of oil."

This is but one more powerful story of Cities Service Lubrication . . . a graphic illustration of the kind of results you can expect from these highest quality lubricants. Why not get the whole story from a Cities Service Lubrication Engineer? Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

Ralph E. Cottrell, Power Boss of Newkirk, Oklahoma. All of Newkirk depends on him as Supt. of Utilities. He depends on Cities Service Lubricants for town's power generators.

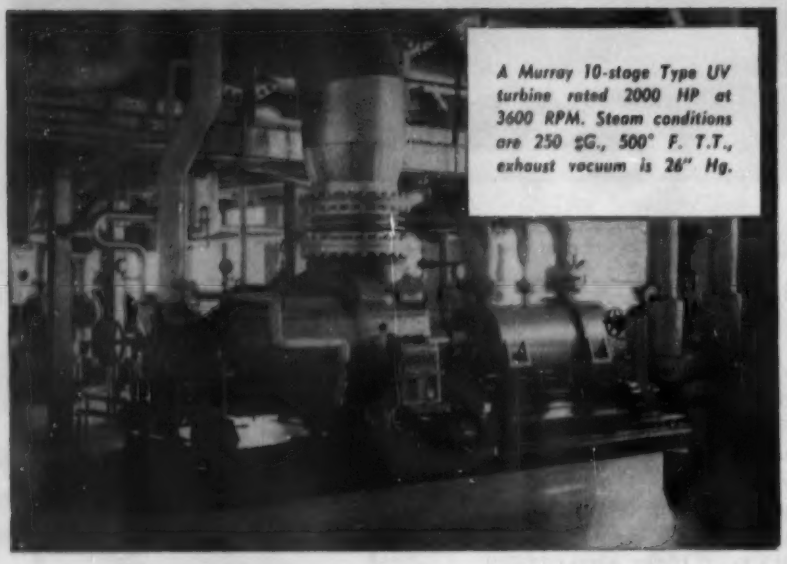


Powerful Machine Behind The Court is this Fulton 800 H.P. dual-fuel generating unit. For seven years Newkirk's only major power source, it gave "faultless performance" using Cities Service Lubricants.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Murray Turbines



A Murray 10-stage Type UV turbine rated 2000 HP at 3600 RPM. Steam conditions are 250 #G., 500° F. T.T., exhaust vacuum is 26" Hg.

● The Murray Type UV turbine pictured above has been driving a high pressure lean oil pump in a Southwestern refinery for the past 10 years. And is still giving dependable, trouble-free service.

Murray mechanical drive turbines both single and multi-stage can be furnished in a wide range of ratings for steam pressures ranging from 0 to 600 #G., condensing and non-condensing. Types in the higher pressures available for up to 250 #G. back pressure.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

MARMADUKE

Continued from page 196

him. 'The blower firm should have wedged up the shaft so the balls didn't take all those impacts with every turn of that flat wheel. And the railroad is at fault for using a faulty car. Chances are you can fight it out with both of them and get your money back for the new set of bearings.'

"Next morning the new bearings arrived. By noon those fans were being driven with their 75-hp motors at their full 1200 rpm. They didn't make a sound—smoothest blowers I ever saw. Those double-row ball bearings were OK and everyone was happy.

"The boss told me I saved him money and said the $200 was a fair price for my advice.

" 'That's nothing,' I answered. 'I've seen a truck load of new electric motors give the same trouble when they arrived straight from the factory. I'd never ship a piece of machinery without taking the load off the balls.'

" 'And I've seen false Brinelling in bearings from vibration or from very small movements while the bearings didn't even rotate. Same condition can also develop in bearings having a very light load, but that's caused by wear, although it looks like false Brinelling.'

"After straightening out those blowers, I was aces with everyone around there except the foreman," wound up Marmy, getting back to work. "The contractor offered me a job in a new plant he was building near Houston. But I heard about a tanker that had just pulled into Beaumont, Texas. Her engineers were being driven nuts because the main drive's dielectric molpulator had a bifocal genometric gudgeon-pintal that kept running 140 C above design rating. I knew that problem would tax my brain more than spotting false Brinelling, so I signed on for a trip to straighten her out."—*SME*

Marmy's Mailbox

I read the Marmaduke stories in each issue of POWER. They are very interesting as well as educational. I've never run across anyone with as varied experience in the power field as that old steam engineer. He must be pretty old to have done all the things he tells about with such authority.

G J TROSKE *Midland, Mich.*

I got a big bang out of Marmy changing water into oil. I know many engineers have been amused by his stories since they contain incidents common to engineering trials and tribulations.

ED BERTLELAN *Winston-Salem, N. C.*

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

POWELL VALVES THE COMPLETE QUALITY LINE

FIG. 1503—W.E. 150-Pound Cast Steel Gate Valve

FIG. 19084—900-Pound Pressure Seal Non-Return Globe Valve, Gear Operated

FIG. 11365—Cast Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

FIG. 3031—W.E. Cast Steel Globe Valve for 300 Pounds W.S.P.

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

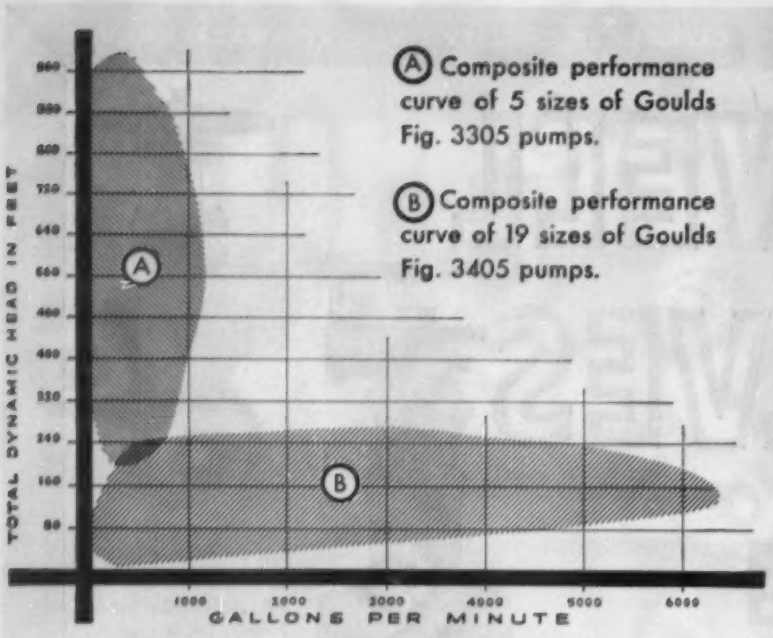
POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

Investigate the many outstanding features of the High Pressure Boiler Non-Return Valve shown above (Fig. 19084). And be sure to find out about the *complete* line of Powell Valves —*quality* valves that will give you dependable flow control.

The valves shown above are examples of the many types of precision-built valves that carry the Powell name and measure up to the Powell standards of quality.

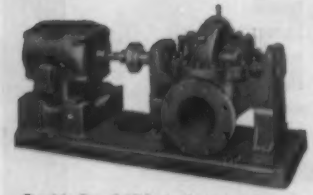
Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write . . .

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year

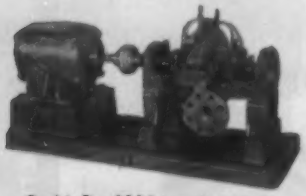

TOTAL DYNAMIC HEAD IN FEET
GALLONS PER MINUTE
A Composite performance curve of 5 sizes of Goulds Fig. 3305 pumps.
B Composite performance curve of 19 sizes of Goulds Fig. 3405 pumps.

Do you need **pumping capacity?**

. . . or head? . . . or both?



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

With these two groups of Goulds centrifugal pumps you can meet an extremely wide range of pumping requirements.

For volume pumping, 19 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6,400 GPM, and heads to 280 ft.

For greater pressure requirements 5 sizes of the Fig. 3305 two-stage pump provide heads up to 1,000 ft., and capacities to 1,200 GPM.

Both of these groups of pumps have important new design and construction features that insure efficient operation and long life. Yet, because so many of their parts are interchangeable, *you can cut your parts inventory in two—or better.*

For example, you need only 3 different shafts for all 24 sizes of pumps in both groups.

We'd like to send you additional details about these pumps, including specifications and performance curves. Just write for Bulletin 721.6 about the Fig. 3405 single-stage pumps, and Bulletin 722.6 about the Fig. 3305 two-stage pumps. We'll be glad to send you copies of both.

MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • TULSA

OUTDOOR MOTOR CONTROL

Continued from page 100

problem since compensated units require more compartment room.

But there are other angles to consider in evaluating a compensated relay. Such a device overprotects a motor slightly when ambient temperatures are below 40 C. Reason being that relay trips with a set motor current, disregarding the fact that a larger load can be carried at lower ambients because of motor's additional thermal capacity. However, since this additional hp capacity at lower temperatures is generally not considered during motor application, the reason seldom proves a practical point.

On the other hand, the temperature-compensated unit permits motor operating beyond its desired temperature limit when exposed to a high ambient or intense solar radiation. In such cases, the plant operator is generally eliminating nuisance tripping in exchange for a small decrease in motor insulation life. By studying curves, p 100, you can spot how a temperature-compensated relay can cause unwanted tripping under certain conditions. Example: a 55 C rise motor operated continuously at full-load while subjected to temperatures above 40 C. Here relay will trip unless previously adjusted to a higher rating.

Real Solution? Actually, none of the foregoing methods outlined are ideal solutions to the nuisance-tripping problem. An ideal solution would require a device that recognized not only it's own ambient temperature but the one in which the motor is operating. It would have to consider solar radiation on both control and equipment. Such a device would keep a check on motor's hottest-spot temperature as the most important in determining insulation life.

Actually such a device is not to be had. The ambient-compensated relay is the nearest approximation in that it recognizes source of heat to which relay is subjected. Perhaps the most practical approach is through a combination of judicious compartment arrangement plus ambient-compensated relays.

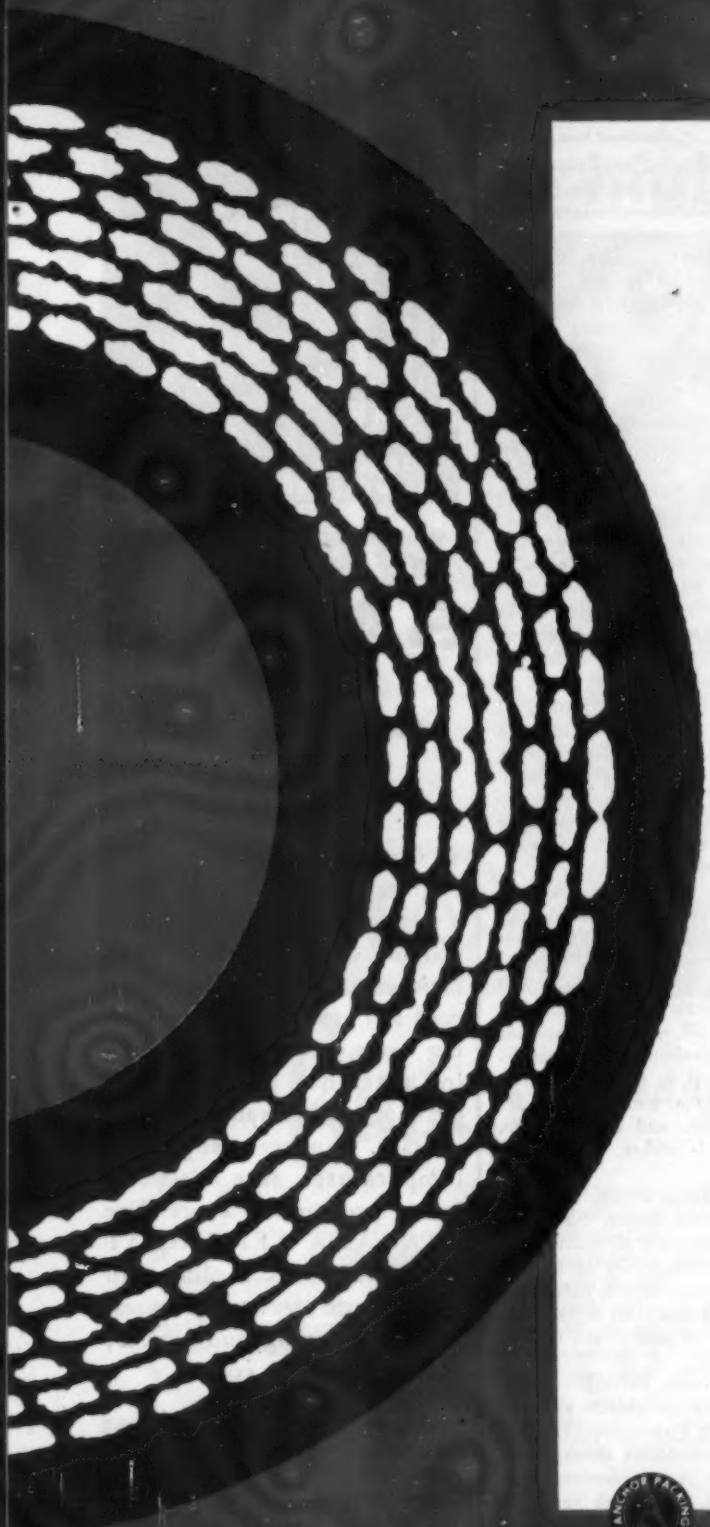
OPERATE FUEL SYSTEM

Continued from page 93

Alarms to warn if coal flow stops in supply pipes are useful, especially for remotely controlled plants.

Fine coal with snow or moisture content is the most likely to build up on pipe walls. Coarse coal tends to scour pipe walls clean; excessively wet coal flows like a fluid.

If you can avoid coal packing, it will



COMPARE

And See WHY Industry Specifies

ANKORITE INDUSTRIAL HOSE

Ankorite industrial hose is especially designed to meet existing conditions and perform specific functions. Review its superior construction features and you will see why industry specifies Ankorite hose:

CONSTRUCTION

There are three basic parts . . . Tube, Carcass and Cover.

THE TUBE

is proofed against harm from air, liquid, oil, gas, acid, heat or other materials. Smooth, it permits free-flow, and is non-porous to free the carcass from seepage of harmful substances.

THE CARCASS

is strong and rugged, easily withstands pressures and temperatures with a wide margin of safety. Will not break down even under the strain of continuous flexing. Made of cotton duck plies or braids impregnated with rubber compounds to bond firmly.

THE COVER

is made to withstand external abuse from abrasion, rough treatment, or harmful materials.

FREE COPY

of a new color folder describing ANKORITE HOSE will be sent you upon request. Write for your copy today.

DISTRICT OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N. Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

MERCOID

PRESSURE & TEMPERATURE

CONTROLS

ENGINEERED FOR SEVERE OPERATING CONDITIONS

Series "D"

Only Mercoid Offers

● *HERMETICALLY SEALED CONTACT*

Always dependable—whether it operates once per year or several times per minute. It remains operative at all times because dust, dirt, grease or moisture cannot contaminate the contacting elements. There can be no sticking or welding of the contact points.

● *OUTSIDE ADJUSTMENTS*

Independent outside adjustments are provided for setting both the cut-in and cut-out points. Differential may be widened as desired. No tools are required.

● *VISIBLE CALIBRATED DIAL*

No guesswork or calculations are required—the pointers indicate on an accurately calibrated dial, the exact operating pressures or temperature.

● *VISIBLE OPERATION*

You can tell at a glance whether switch circuit is on or off.

● *BOURDON TUBE OPERATED*

UL

UNDERWRITERS' APPROVED

All operating ranges for Series DA-21, DA-35 and DA-55.

Available for general use, outdoor use or hazardous locations.

WRITE FOR BULLETIN 48

THE MERCOID CORPORATION

4211 Belmont Ave., Chicago 41, Ill.

OPERATE FUEL SYSTEM

Continued from page 200

help prevent plugging coal pipes and bunker outlets. Use straight, amply sized pipes without unnecessary internal roughness or obstructions. If coal flows so erratically that pulverizer operation is affected, turn on lighting torches and, if necessary, reduce load to a point that can be handled.

Between bunkers and pulverizer or stoker there is usually some means for measuring coal. Weigh larries, coal dump scales or movement counters are most frequently used. Check their accuracy frequently so daily records of consumption will be as close as possible to actual use.

In some plants, bunker measurements are made nightly and used in connection with weightometer measurements or car weights to determine the coal burned. Revolution counters on underfeed stokers also give a fair indication of consumption.

To get a fully accurate picture of consumption over a period of time, you must also survey the coal in storage piles. Use tape line, surveying instruments, or aerial contour survey to determine the volume on hand. Determine an average weight per cubic foot by weighing compacted volumes, or by actual measurement of a pile with a known weight. Then apply the average weight to the volume on hand to calculate total tonnage in storage. Coal previously on hand, plus amount received over the period, minus that on hand at end of the period, gives the amount burned. Make level-ups at intervals depending somewhat on the coal in storage, the accuracy of measurements for daily consumption, and other factors. Usual interval is either monthly or yearly.

From the weighing device, coal may pass to a pulverizer feeder. Some element of the pulverizer or combustion control actuates the feeder to keep a proper level of coal in the pulverizer. Feeder runs on a stop-start or variable-speed basis to feed coal to the mill as required.

Here are some possible feeder troubles: (1) Foreign objects stop the coal or the feeder's operation. (2) Excessively dry coal slides through the feeder even if it is not running, overloading the mill. (3) With very wet and sticky coal, feeder does not pass coal fast enough. (4) Pulverizer control element and feeder both operate improperly. Inspect feeders and controls frequently to see that they are running as intended. Be sure to lubricate regularly.

Next installment will describe how to operate the four common types of pulverizers.

WATER SAVING

with

TROUBLE-FREE COOLING EQUIPMENT

● Cools your jacket water for engines or process equipment or electric apparatus. Your closed system keeps free from dirt or maintenance troubles. You can cool air, gases, chemicals, plating baths, quench baths, welding machines, extrusion and drawing machines and hydraulic presses. You get real precise temperatures, save rejections, lower production costs. Use NIAGARA AERO HEAT EXCHANGER cooling with atmospheric air . . . saves water, pumping, piping and power; quickly saves its costs.

Write for Bulletins No. 120 and 124

●

Convenient Units Up To 30,000,000 BTU Capacity

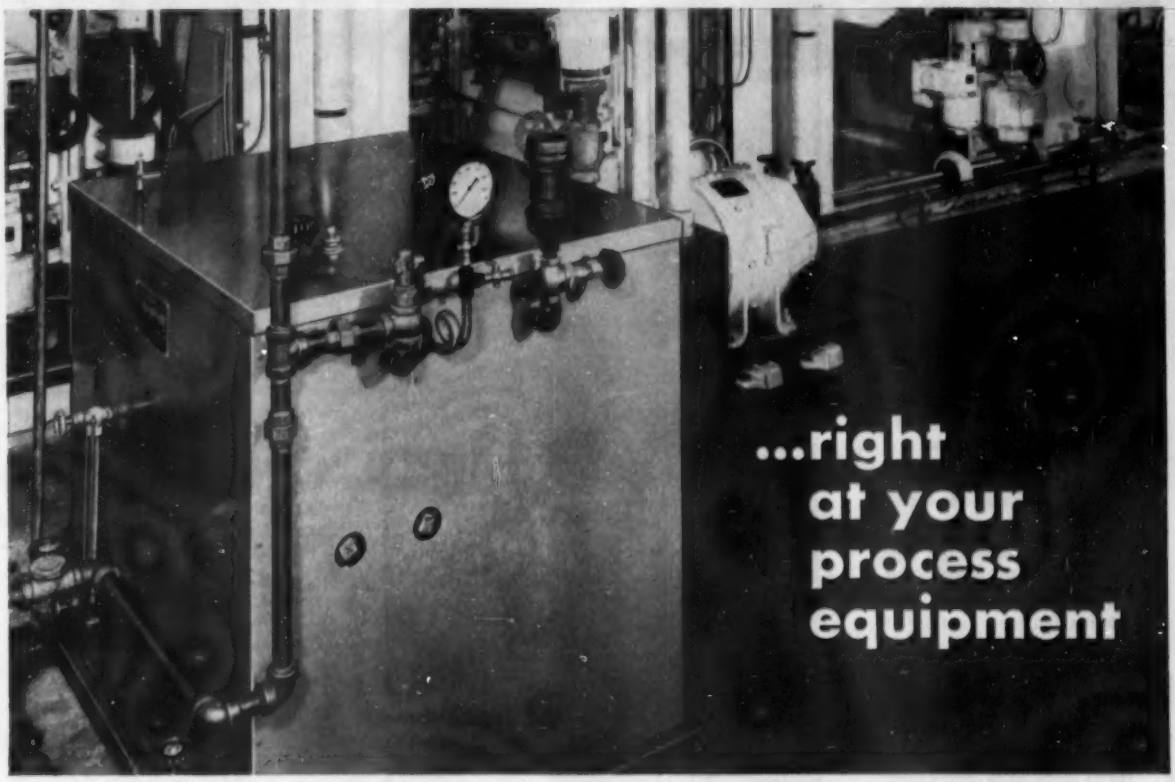
NIAGARA BLOWER COMPANY

405 Lexington Ave., New York 17, N.Y.

District Engineers in Principal Cities of U. S. and Canada

for as little as $685

you can have high pressure steam



with a Pantex Speedylectric Steam Generator

Think of it! — Speedylectric lets you have constant temperature "dry" steam wherever you want it for as little as $685. Install it near your platen presses, or for degreasing, and phosphatizing, or on jobs that are remote from your central boiler. No fumes, no flame, no smoke-stacks or other complicated installation problems. Just plug in to either 220, 440 or 550v outlet, connect piping, and you have an ever-ready source of high pressure steam that you can control precisely.

Speedylectric utilizes the electrode principle — the simplest, lowest cost method for generating steam electrically. It has no coils, tubes or electric elements to scale and burn out. No feed water treatment or daily blow-down is needed. Equally important, Speedylectric is safe from fire dangers . . . no open flame or low water explosion hazards. (Underwriter's Laboratories Listing) 1 to 60 Bhp; 15 to 500 Psi. Why not write for complete data and illustrated Bulletin.

Among leading users are: Aluminum Co. of America • Boeing Airplane Co. • Celanese Corporation of America Cutler-Hammer, Inc. • Dow Chemical Co. • Eastman Kodak Co. • Ford Motor Co. • General Electric Co. Liggett & Myers Tobacco • Republic Steel Corporation • Shell Oil Co. • Westinghouse Electric Corporation

Speedylectric Steam-Jet Cleaner lets one man do the work of five. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment *without* flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

Pantex Manufacturing Corporation
Box 660Y Pawtucket, R. I.
Send me complete illustrated data on:
☐ Pantex Speedylectric Steam Generators.
☐ Pantex Speedylectric Steam-Jet Cleaners.

NAME AND TITLE _____
COMPANY _____
ADDRESS _____

Verti-Line PUMPS *were first— are first*

Virtually every major turbine pump improvement has been pioneered by the makers of Verti-Line Pumps. For instance:

first to produce a vertical pump for small diameter casing.

first to place the line shaft inside of the discharge pipe enclosed in a protective tube.

first to introduce line shaft lubrication from surface of ground.

first to introduce a full-floating ball thrust bearing head.

first to design high efficiency enclosed impellers.

first to introduce factory practices to insure proper shaft alignment.

first to introduce and pioneer the hollow-shaft motor head.

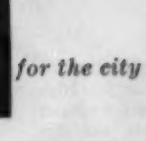
first to adopt the streamlined, weatherproof, built-in motor.

first to employ highly technical methods for statically and dynamically balancing rotating parts.

LAYNE & BOWLER will continue to be FIRST in presentation of improvements.

in all industry

on the farm



for the city

More than 100,000 satisfied vertical pump users agree there's no pump like Verti-Line for low first cost, economical operation, and negligible maintenance. Whatever your vertical pump needs may be, it will pay you to investigate Verti-Line before you buy.

Send for your free copy of our new booklet "Pumps For Sale." Ask for Bulletin 0-85.

Verti-Line Pumps are the exclusive products of

LAYNE & BOWLER PUMP COMPANY

general offices and main plant

2943 VAIL AVENUE • LOS ANGELES 22, CALIFORNIA

More TECHNICAL BRIEFS

Begins on page 152

speed regulation and control can be obtained by use of magnetic amplifiers with simple feedback circuits. This is particularly true where motor speed must be adjusted remotely or by resultant of two or more control signals. Moreover, speed-torque characteristics of the motor and design parameters of auxiliary apparatus are relatively straightforward to predict. *AIEE paper no. 55-60.*

Some considerations on the construction of electrical machines for operation under tropical climates. *By Dr Ing Marco Signorile, The Italian National Committee.*

After a careful survey of characteristics that electrical machines should have for tropical climates, particularly from the viewpoint of long life, a conclusion is reached that such machines are fundamentally just ordinary units for mild climates, improved in their mechanical parts to obtain good resistance to corrosion, and in their electrical parts to ensure an acceptable duration of insulation life, even in the presence of moisture, mould-generating organisms and parasites.

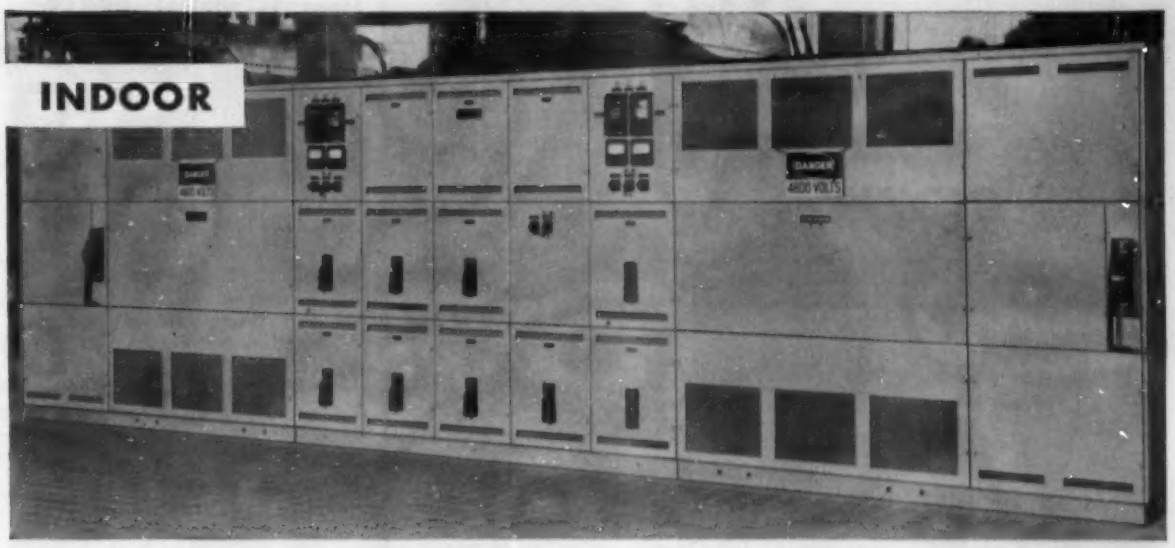
To reach this aim, materials and treatments to resist corrosion, ordinary impregnation varnishes, special fungicide enamels, finishes and impregnation lacquers are employed. For ratings below a certain limit a totally enclosed construction is advisable. In stationary machines the active part is normally protected to withstand tropical climates.

Particular difficulties in design to provide for the required protection do not exist; an increase in production cost is however to be taken into account, by equal rating, as compared with machines for ordinary applications in temperate regions. The Italian electro-mechanical industry has to its credit excellent experience in construction of machines for tropical climates, which it has already produced and is in condition to produce, of any size and rating. *WPC paper; no number.*

Rewinding a-c generators for improved performance. *By W G Seline, The Shawinigan Water and Power Co.*

The Shawinigan Water and Power Company has an installed capacity of 1.5 million horsepower in six hydroelectric plants located on the St. Maurice River, Quebec. The company maintains its own electrical repair department and rewinds all its own generators. During the last ten years, nine

Directions for ordering papers on p 212



I-T-E, single source of supply for complete Unit Substations

You can buy a unit substation either of two ways: a piece at a time (the expensive way), or all at once (the economical way). I-T-E can sell you the individual elements, but recommends that substations be purchased complete, and from a single source of supply.

This way, you get more value from I-T-E's engineering assistance in over-all planning. The unit substation, including primary breakers or switches, liquid or dry type transformers, and secondary distribution switchgear with air circuit breakers, is assembled, tested and shipped as a unit ready for immediate installation. You have one dependable company that stands behind your complete installation.

I-T-E Primary and Secondary Unit Substations can be supplied for any application indoor or outdoor, and in any standard rating. For details, contact the I-T-E sales office nearest you. Look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY, Switchgear Division

—as easily and quickly as you can draw circles with a compass.

The Allpax gasket cutter uses our patented "Ironing" principle that presses the material flat to prevent buckling and tearing while cutting. It cuts circles from ¼" to 36" in diameter to a tolerance of 1/64". Why risk costly delays in operation when you can replace a gasket in a jiffy with this handy tool.

SEND FOR OUR NEW CATALOG TODAY!

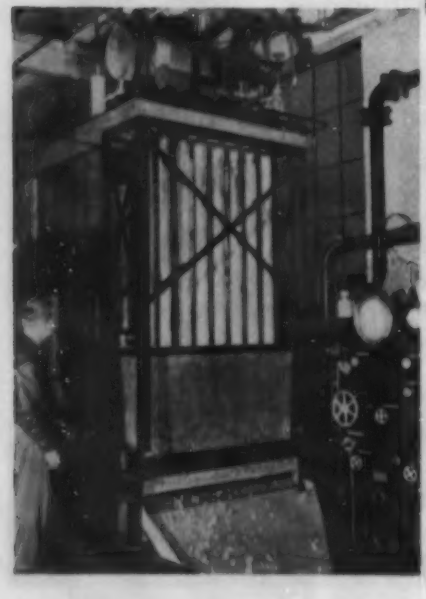
See our complete line of packings, tools, and gasket materials. Contact our distributor or write to:

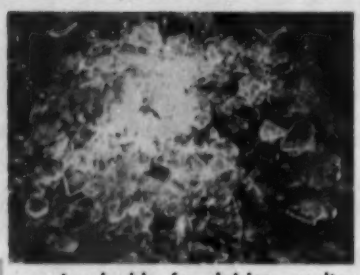
THE ALLPAX COMPANY
805 Mamaroneck Ave. • Mamaroneck, N. Y.

A New Money-Saving Product—

FRICK

Shell-Ice*





Invaluable for dairies, poultry plants, fishermen, shippers, hotels, restaurants, etc. Curved pieces of Shell-Ice, ⅛ to ½ in. thick, are solid and hard, and with average good water are clear. Delivered broken to the size desired, they can be shoveled, conveyed, bagged, or blown through a hose. Automatically frozen and harvested—no labor, brine, snow, waste, or special cleaning.

Shell-Ice Makers are built in capacities of ½ to 30 tons per 24 hours. Small floor space suffices. Patents pending. Get full facts on this highly economical new kind of ice: ask for Bulletin 54, available in English and Spanish. Write today.

*Trade mark

FRICK CO.

More TECHNICAL BRIEFS

Begins on page 152

machines totalling 240,000 kva have been rewound.

Two years ago the company had the problem of rewinding the first of a group of five generators that had originally been overrated with a temperature rise of 110 C. The problem was to reduce the rise to a more normal value without reducing output. Some fundamental design changes were made to reduce operating losses and a new insulation structure developed with greater thermal conductivity. Test results indicated that the new insulation had an appreciable effect on temperature reduction.

Subsequently the same type of insulation was applied to another generator with different output, voltage rating, and original insulation. Again an appreciable decrease in temperature rise occurred. This insulation is now standard in this company for all rewind jobs and results of better heat conductivity are used to reduce temperature rise where required but more generally to increase kilowatt output when adequate capacity is available from the turbine or the reactive kva output where sufficient field and exciter capacities exist.

This paper describes operating history of the machines, their original insulation components, new insulaton and results of rewinding on the temperature rise versus output characteristics. *AIEE paper no 55-132.*

Engineering materials

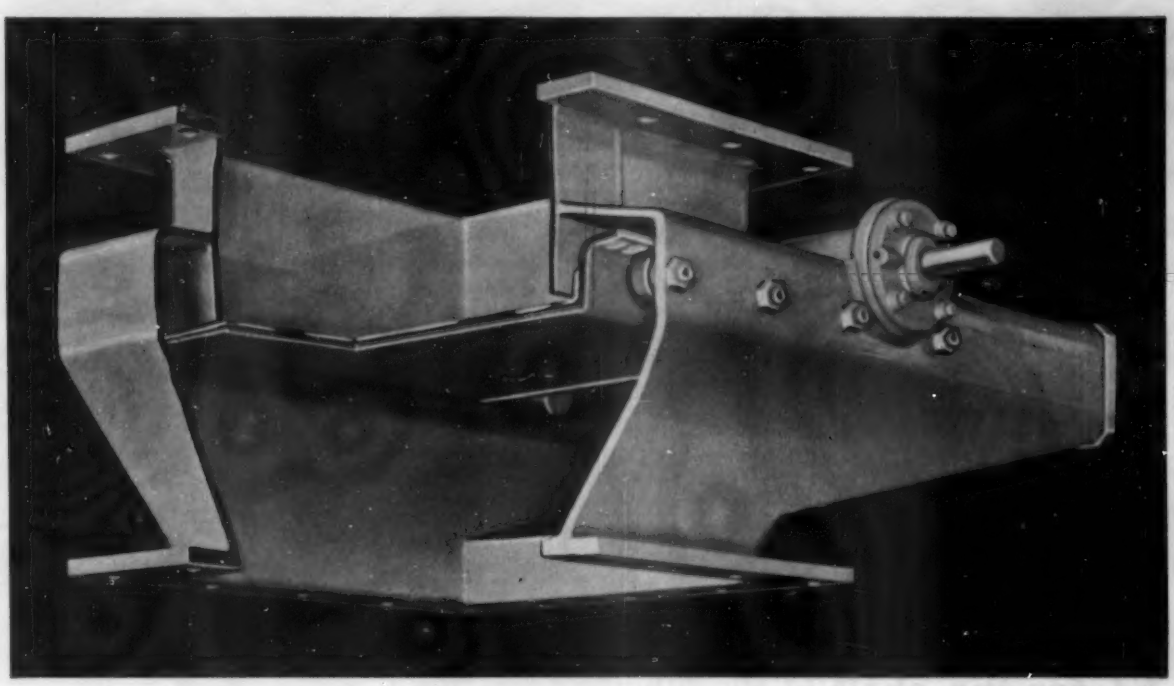
Biaxial plastic stress-strain relations of a mild steel for variable stress ratios. *By Joseph Marin and Ling-Wen Hu, The Pennsylvania State University.*

Main objective in the study reported in this paper was to provide further experimental checks on validity of the simple flow theory of plasticity. In this investigation, biaxial stresses were produced by subjecting tubular specimens to internal pressure and axial tension. Tests were made on specimens machined from cold-drawn seamless-steel tubing.

Most of the tests were performed under variable biaxial-stress ratios, but to provide necessary control data and basic biaxial strength properties, a series of constant stress-ratio tests was also conducted. Eight different types of variable stress-ratio tests were devised to determine validity of the simple flow theory. Results of these tests do not support the theory.

A test was also made to check valid-

Directions for ordering papers on p 212



Here's The Inside Story On The New
S-E-CO. Coal Valve

Strip the ⅜" steel skin off our new coal valve and you'll quickly see why *you get more when you buy S-E-Co.*

First, notice the deep U-shaped gate which completely shields rollers, racks and pinions from coal flow. See how the gate provides lap closure on all four sides assuring positive cut-off. Also, note the stainless steel liner on top side of the gate to combat corrosion.

Carefully formed ladder racks, for their part, are self-cleaning having no root portion in which coal dust can build up and cause jamming. The multi-faced pinions, located above the racks, are also of self-cleaning design. Consequently, the gate moves smoothly with little effort, even after long periods of not being operated.

Notice the clean interior design. Slopes have been kept at a maximum with shoulders and projections eliminated. Even the poke hole covers fit flush with the inside of the valve body so that nothing interferes with flow of coal through the valve.

For a complete list of all the outstanding features of the new S-E-Co. Coal Valve together with installation photographs and dimensions, write for Bulletin No. 97.

STOCK Equipment Company

745-P, HANNA BLDG., CLEVELAND 15, OHIO

"1 for the gauge

2 for the shelf"

Saves you time . . .
avoids boiler breakdown

Reduce maintenance time on boiler water-level gauges. For every gauge in your plant, order *two* spare gauge glasses.

Why? Here's why:

Spare No. 1 is handy for you when you need a gauge glass for regular replacement during routine maintenance.

Spare No. 2 is your emergency protection against lost time, if you should suddenly need a replacement because of accidental breakage.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	Recommended Product
Normal conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnace, reactors, pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge	PYREX brand oil-cup glasses

Your Industrial Distributor has the best —gauge glasses by Corning. Call today!

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

More TECHNICAL BRIEFS

Begins on page 152

ity of the distortion-energy criterion as used in the simple flow theory. Differences between the theoretical and experimental results for this test were too great to be explained as due to experimental error or material anisotropy. A special variable stress-ratio test was also conducted to compare certain requirements of both the slip and simple flow theory. Results from this test were in poor agreement with the simple flow theory and in approximate agreement with the slip theory.

An investigation was made to determine validity of the so-called "loading function" as required by various plasticity theories. These test results do not agree with the concept of a loading function. *ASME paper no. 54-A-243.*

Thermodynamic properties of methane-nitrogen mixtures. *By O T Bloomer, B E Eakin, R T Ellington and D C Gami, Institute of Gas Technology.*

This bulletin presents data on thermodynamic properties of methane-nitrogen mixtures, required for computing energy requirements of processes to separate nitrogen from natural gas by liquefaction and distillation, for calculating compressor and expansion turbine energy requirements, for determination of heat-exchange loads, for calculating throttling temperature drops, and for other uses. Examples of use of the data in these calculations are given.

Two mixtures of methane and nitrogen, one containing 10% and the other 30% nitrogen, were selected for demonstration. The enthalpies, entropies and compressibility factors of the mixtures are presented in tabular form and as charts of enthalpy versus entropy, entropy versus temperature, and compressibility factor versus pressure. Range of these charts and tables for the vapor phase is from saturation at −284 F to superheated vapor at 2000 F and pressures from 10 to 1500 psia, and for the liquid phase, from saturation at −258 F and 100 psia to the critical point.

For the superheated-vapor region, properties of the two mixtures were calculated by use of zero-pressure heat capacity data and an equation of state for methane-nitrogen mixtures. For the two-phase liquid-vapor region, calculations were based on experimental pressure-volume-temperature data obtained at the Institute of Gas Technology for mixtures of methane and nitrogen.

Constant-pressure enthalpy versus composition charts are also presented for pressures of 100, 200 and 300 psia. These charts were constructed with

Directions for ordering papers on p 212

Stop Corrosion
in boilers, steam and return lines . . .

with this Stickle deaerating feed water heater

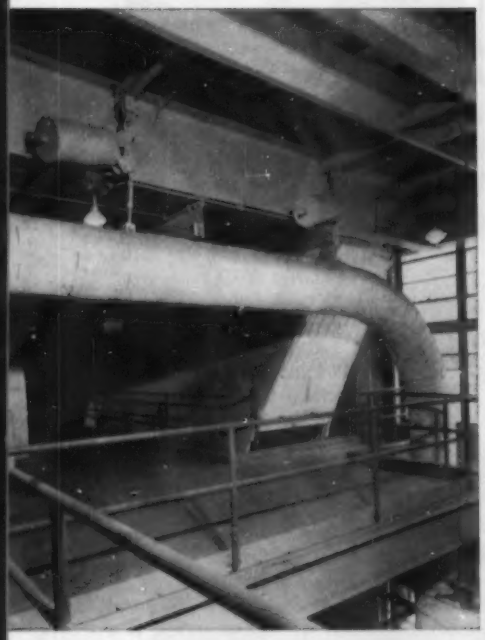
SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

FREE CATALOGS!
S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment
Cuts the cost of steam



This station, having an initial capability of 276,000 kw, was designed and erection supervised by Gilbert Associates, Inc., Reading, Pennsylvania. It is one of the most efficient and low-cost stations in the country.

At the new Shawville Station of Pennsylvania Electric Co.

it's NAVCO Piping throughout

Over 37 miles of pipe were installed by Navco in this highly efficient reheat station and all necessary prefabricated assemblies, in excess of 2,000,000 lbs., were produced in Navco shops. For field welding only, more than 15 tons of electrodes were used.

The photo above shows one of the bends required for the Main Steam. It is 16″ O.D. forged and bored with a wall thickness of 3.084″ and weighs 5½ tons. Material is ASTM A-335 P-22—2¼% Chrome. Operating conditions are 1850 psi at 1050°F. initial, with 1000°F. reheat.

The photo at the left shows this bend in service supported by dependable Navco Counterpoise Hangers.

In the past three years alone, Navco Piping has been installed in Central Stations generating in excess of 4,000,000 kw.

Next time you have a Piping job requiring reliability in performance and careful attention to every small detail, Navco will welcome the opportunity of quoting you.

Call, wire or write today!

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

The Ideal Packing for Centrifugal Pumps
"JOHN CRANE"
SUPER-SEAL®
over fifteen years of outstanding service records
...Now with "tape-back" reinforcement
★ SIMPLIFIED RING CUTTING—Easily pulled down to any shaft or stem size.
★ POSITIVE PACKING IDENTIFICATION—Each style marked in a different color.
Super Seal is an extremely resilient, graphite impregnated, homogeneous plastic packing composed of asbestos, metallic particles and special binders.
This packing is ideal for centrifugal pumps in a wide variety of power plant services. It doesn't give up its lubrication, it stays resilient and it won't score shafts. You'll find it will outlast any packing you've tried. There are no continual adjustment problems with Super Seal, because it stays put!
"Tape-back" construction meets your need for flexibility without breakage—for ring cutting without waste. Here, for the first time, is a plastic packing which can be handled as easily as braided fabric styles.
It's hard to believe the resilience of "tape-back" SUPER SEAL until you twist it down yourself. Send for a sample and try it.
Crane Packing Co., 1830 Cuyler Avenue, Chicago 13, Illinois.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.
JOHN CRANE
CRANE PACKING COMPANY
38 YEARS INDUSTRIAL PROGRESS
OFFICES IN ALL PRINCIPAL CITIES

More TECHNICAL BRIEFS

Begins on page 152

data on mixtures containing 10, 30 and 70% nitrogen, and published data on thermodynamic properties of pure methmethane and pure nitrogen. *IGT Bull.*

Properties of cast iron at elevated temperatures—a progress report. *By J R Kattus, Southern Research Institute.*

This investigation is intended to determine the load-carrying ability of cast iron in the temperature range of 700 to 1000 F. Screening tests, stress-rupture and creep tests, and thermal-shock tests, are to be carried out. This report covers a literature survey and screening tests on twelve commercial irons to determine their resistance to softening at elevated temperatures.

These tests showed good correlation between alloy content and resistance to softening, but the literature survey showed only partial correlation between creep and stress rupture and other elevated-temperature properties. Based upon results of the literature survey and screening tests, a selection of eight irons for stress rupture and creep testing was made.

Irons with ferritic matrices are softer than those with pearlitic matrices in the as-cast or heat-treated conditions. During annealing at 1100 or 1200 F for extended periods of time, however, ferritic irons do not lose as much hardness as those with pearlitic matrices. Final hardness is apparently more dependent upon alloy content than upon the amount of ferrite and pearlite in the original structure.

Presence of martensite in the starting structure seems to contribute somewhat to retention of hardness after annealing at 1100 and 1200 F. In general, the type of alloy additions has a greater effect upon final hardness than does graphite or matrix structure. *ASME paper no. 54-A-162.*

Steam turbines

Overspeed protection of reheat turbine-generators. *By M A Eggenberger, General Electric Co.*

Besides normal functions of control and protection, the control system of a reheat unit must be able to protect the turbine generator effectively against excessive overspeed that could be produced by stored steam in the reheater. This protection originally was obtained by a single line of defense consisting of the pre-emergency control system that operated the intercept valve.

However, as development of reheat units progressed rapidly, it was found

Directions for ordering papers on p 212

TAKES THE THRO[illegible]UT OF POWER

PENFLEX TUBING

"SOAKS UP" VIBRATION . . . PROVIDES SMOOTHER COOLING OPERATION

WHEN A 16-cylinder, 1,750-hp diesel engine roars into action, the air-cooling and circulation piping really has to "take it." This particular installation performs perfectly because it is equipped with Penflex Flexible Metallic Tubing. A 5-foot length of air-jacketed 14" interlocked Penflex Tubing reaches from exhaust to stack. Its tough, rugged, "seep-proof" construction holds exhausts tight as a pipe . . . yet it is flexible enough to absorb the constant vibration.

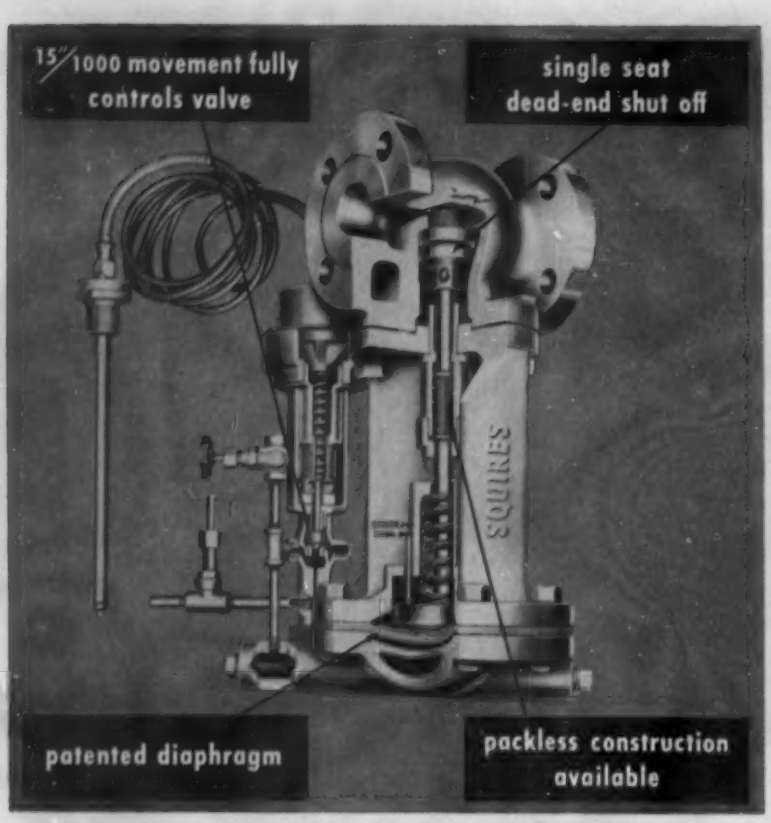
In the power field you have many calls for Penflex—for air and gas lines, for transmission of oil, steam, and liquids. There is a complete line of steel, bronze, and aluminum Penflex Flexible Tubing, Hose and Couplings in sizes from 1/8" to 24" I.D.

Write today for new illustrated data book on "Flexineering"—the science of engineering flexible tubing to your specific job.

Pennsylvania Flexible Metallic Tubing Company, Inc.
7237 Powers Lane, Phila. 42, Pa.
Offices: Boston • New York • Chicago • Houston • Cleveland • Los Angeles

PENFLEX

HEART OF INDUSTRY'S LIFE LINES



How to control process temperatures to within plus or minus one degree

When you use steam or water as a heat source, close control of process temperatures is simply a matter of using a temperature regulating valve that has precise accuracy. A Squires Pilot Operated Temperature Regulator provides plus or minus one degree control because the pilot valve only has to move .015 inches to fully open or close the main valve. *In actual operation, the pilot valve only moves .004 inches (the thickness of an ordinary piece of paper) to modulate the main valve. Thus, movement of pilot bellows is so slight that long pilot life is assured . . . maintenance is practically non-existent . . . long range cost is lowest in the industry.*

Complete elimination of temperature override is another requisite. A Squires Valve gives guaranteed dead-end shut off. High pressure closes the main valve and absolutely no additional steam is permitted to pass through the valve.

Instantaneous wide open capacity to meet high demands is a third advantage. The exclusive Squires Patented Diaphragm achieves maximum deflection and traverse because of its flexibility. The full effective open position of the main valve is reached the instant the pilot valve opens.

For additional information on how to get better control of steam, water, air or gas, write for Squires Valve Booklet No. 5417. The C. E. Squires Co., 18502 Syracuse Ave., Cleveland 10, Ohio.

S-103

SQUIRES

More TECHNICAL BRIEFS

Begins on page 152

that potential overspeed in the reheater on most units became so high that a second line of protection was needed in order to insure adequate safety. This paper discusses reasons why the author's company decided to install reheat stop valves as a second line of defense against stored energy in the reheater. It also describes methods of calculation used to determine maximum speed that would be reached if a single line of defense would fail to operate and discusses other methods of secondary protection. *ASME paper no. 54-F-26.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Power Conference, 17th annual meeting. Identified by initials APC and obtainable through purchase from R A Budenholzer, chairman, Illinois Institute of Technology.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

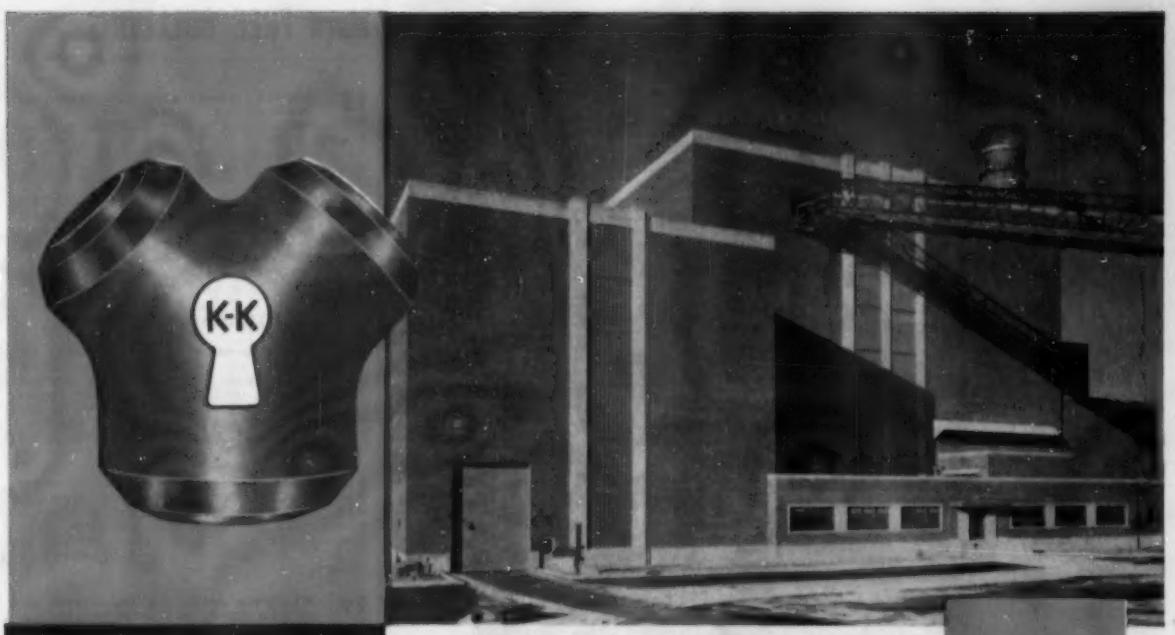
World Power Conference, 4th meeting. Identified by initials WPC and obtainable from Secretary, Brazilian National Committee, WPC, Rua Visconde de Inhauma, 134-15 Pav, Rio de Janeiro, Brazil.

Institute of Gas Technology. Identified by initials IGT and obtainable through IGT, 17 W 34th St, Technology Center, Chicago 16, Ill.

McGill Manufacturing Co, Inc, a producer of electrical equipment and bearings, is observing its 50th anniversary.

City of Seattle has received authority from the Federal Power Commission to install a fourth 90,000-kw generator at its Ross hydroelectric plant on the Skagit River.

San Diego Gas & Electric Co has announced a $19-million construction budget. Largest item is $7-million for continuing work on the $12-million Unit 2 of the Encina generating station near Carlsbad.



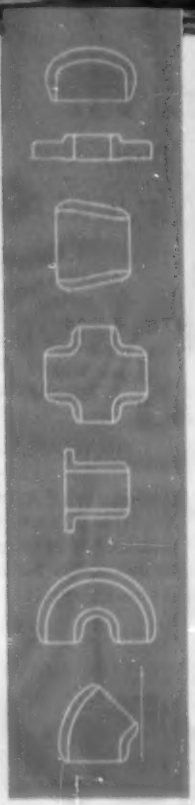
KEY-KAST "Y" FITTINGS

serve main steam, hot reheat lines of new power plant

Insistence on unfailing strength and complete dependability was a major factor in Potomac Electric Power Company's selection of Key-Kast Alloy Welding "Y" Fittings for the main steam and hot reheat lines of its Potomac River Plant, Alexandria, Virginia.

These rugged Key-Kast fittings offer greater strength and longer life for power systems for these reasons:

- Increased structural strength, with greater wall thickness throughout
- Greater allowance against erosion, with extra thickness at critical areas
- Produced by most economical method
- Available in all shapes, sizes, schedules . . . in low and intermediate alloys and various stainless steels
- Meet A.S.M.E., A.S.T.M., A.S.A. Codes
- Controlled quality, through rigid metallurgical control



Whatever your alloy piping need, you'll find a Key-Kast fitting to fill it.

Key company

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

P.O. BOX 494-C, EAST ST. LOUIS, ILLINOIS

DISTRICT OFFICES: NEW YORK • CLEVELAND
CHICAGO • TULSA • HOUSTON • LOS ANGELES

DOUBLE BOILER BLOW-OFF SAFETY

1

Quick-Operating EVERLASTING Straight-Through Valve

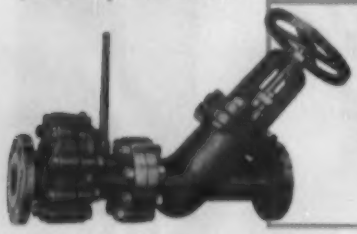
The standard Everlasting design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use.

2

Shock-Resisting EVERLASTING Angle Valve

Specially designed and stoutly constructed to withstand severe service and the shocks and abrasion of blow-down solids.

Conform with ASME codes. Available in a range of sizes for pressures up to 600 psig. *Write for descriptive bulletin.*



EVERLASTING DUPLEX UNITS

also available with Y Valves and in any combination of Quick-Operating, Angle and Y Valves.

For "everlasting" service, use

EVERLASTING *Valves*

EVERLASTING VALVE CO.
45 FISK STREET, JERSEY CITY 5, N. J.

EV 355

More FREE BULLETINS

Begins on page 165

15 **Liquid rheostats** for stepless, wide-range speed control of wound-rotor motor drives. Photos, diagrams, charts in 8-p bulletin 14B8231. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wisconsin.

16 **Limit switches.** Illustrated 12-p file-folder-type catalog contains data on contract arrangements, amp ratings, operation, electrical characteristics of *Losswitch* units. Dept. P, The R B Denison Mfg Co, 102 St Clair Ave, NW, Cleveland 13, Ohio.

ELECTRICAL EQUIPMENT

17 **Transformers.** Dry-type units for indoor or outdoor use, available in single-phase types in sizes 50 kva and smaller, and in three-phase types, sizes 30 kva and smaller, 600 v and below. Illustrated 4-p bulletin 61B8222, Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wisconsin.

18 **Batteries** for use in control, switchgear, emergency lighting and auxiliary power fields. Photos, specs, design and construction data, dimensions in 4-p bulletin CP-538/55. C & D Batteries, Inc, Conshohocken, Pennsylvania.

19 **Portable cords** for industrial use where cords are exposed to elements and subjected to abrasion, crushing, impact, shock, moisture, oils, acids. Illustrated 8-p bulletin DM-5538. Anaconda Wire & Cable Co, 25 Broadway, New York 4, New York.

20 **Vertical motors,** hollow-shaft, high-thrust type ranging from 7½ to 500 hp. Illustrated 12-p bulletin GEA-6280 emphasizes reduced maintenance costs and simplified lubrication of *Tri-Clad* motors. General Electric Co, Schenectady 5, New York.

21 **Explosion-proof motors** in ratings from 1 to 10 hp. Cross-section, photos, drawings, complete data on totally-enclosed units for operation where fumes, dusts, combustible materials and moisture are prevalent. Bulletin 1879. U.S. Electrical Motors, Inc, Box 2058, Los Angeles 54, Calif.

22 **Electric motors.** Polyphase, single-phase and dc units in rating from ⅛ to 30 hp. Illustrated, 8-p bulletin SDA-155 contains selection data, standards and specs. The Peerless Electric Co, Motor Div, W Market St, Warren, Ohio.

MAINTENANCE MATERIALS

23 **V-ring packings** is subject of 4-p bulletin 4-R-10. Contains photos, schematic drawings, engr data. The Belmont Packing & Rubber Co, Butler & Sepviva Sts, Philadelphia 37, Pa.

24 **Packings.** Bulletin CP552 gives descriptions of *Teflon* ring packing, impregnated asbestos packing, V-type packing and patented *Teflon* seal gage. Photos, installation diagrams, 4 pages. Chemical & Power Products, Inc, 11 Broadway, New York 4, N. Y.

25 **"Clipper oil seal"** is title of 28-p illustrated manual. Contains info on selection, application and installation of *Clipper* seals. Photos, detailed drawings, case histories. Johns-Manville, 22 E 40th St, New York 16, N. Y.

26 **Floor cleaner** for suction cleaning dust, dirt, trash, etc from large floor areas. Cleans to 20,000 sq-ft-per-hour. Case histories, photos, full specs in 4-p bulletin 551. Handling Devices Co, Inc, 43 Pearl St, Brookline 46, Massachusetts.

27 **Lubrication** and maintenance of ball and roller bearings is discussed in 4-p bulletin 506. Includes data on storage and handling lubricants. New York & New Jersey Lubricant Co, 292 Madison Ave, New York 17, New York.

28 **Fastening tools** for running nuts, bolts, cap screws and other type

eliminate destructive foreign matter in your influent...

JEFFREY traveling water screens remove floating debris and suspended matter from raw water.

An endless chain of traveling screen panels, moving upward on the entrance side, carries refuse to surface. High pressure water spray washes screen deposits into carry-away trough.

USE—in all plants requiring large volumes of water.

EASY INSTALLATION—Compact unit consists of vertical traveling screen, screen baskets, chain, sprays, guides, drive unit, frame, and semi-enclosed housing.

OPERATING ECONOMY—Enclosed ball bearing motor, anti-friction bearing speed reducer with gears running in oil, non-clog spray pipes with quick-opening valves.

STURDY CONSTRUCTION—Welded steel baskets, steel thimble roller chain, cast iron chilled rollers, cold roll steel head and foot shafts, fine mesh wire screen, ⅜-inch structural steel frame.

COMPLETE PROTECTION—End skirts form seal as baskets pass through boot. Adjacent basket cross members overlap to seal basket joint. End skirt flanges cover chain. Speed reducer has overloaded protection.

Jeffrey's broad experience in design and construction covers all types of sanitation system installations. Hundreds of municipal plants and private industrial plants over the entire nation are Jeffrey-equipped. The Jeffrey line includes:

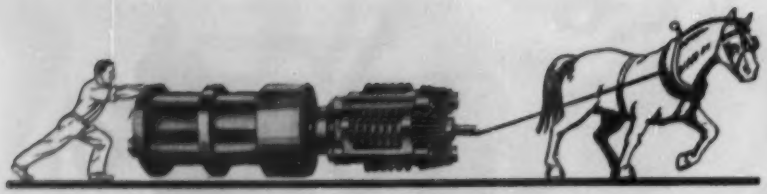
Bar and Disc Type Screens	FLOCTROLS
Screenings Grinders	Dry Feed Chemical Machines
Grit Collectors & Washers	Biofiltration Plant Equipment
Sludge Collectors	Garbage Grinders
Sludge Elevators	Belt and Spiral Conveyors
Scum Removers	Bucket Elevators
Power Transmission Machinery	Chains and Sprockets

Traveling Water Screens

Write Sanitation Sales Division. The Jeffrey Manufacturing Co., Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING



Obsolete Tube Cleaners
waste time, labor, and money

Even if you rarely use tube cleaners, you can't afford to be without a powerful new ROTOJET. A ROTOJET should save you enough in time, labor, and air in one cleanout to pay for itself. You won't believe a tube cleaner can pack such tremendous power until you try the new ROTOJET.

Get a new
ROTOJET®

Model S-530 ROTOJET Air-driven Motor with swing-frame head for 3⅛ - 3-13/16 I D straight tubes

We can ship promptly complete ROTOJET Tube Cleaners for all tube sizes and shapes. Roto heads, brushes, universal joints, air valves, lubricators, hose, and accessories are stocked ready for shipment.

Wire or phone us if you are in a hurry.

ELLIOTT COMPANY-ROTO DIVISION
153 Sussex Avenue Newark 1, N. J.

More FREE BULLETINS

Begins on page 165

fasteners. Case histories, specs, photos, accessories and sockets used on *Impactools*. 52-p catalog 5200-A. Ingersoll-Rand Co, 11 Broadway, N. Y. 4, N. Y.

HEAT EXCHANGERS, CONDENSERS

29 **Condenser tube insert** for putting leaky tubes back in service. Installation data, features in 4-p bulletin 500-A. Thomas C Wilson, Inc, 21-11 44th Ave, Long Island City 1, N. Y.

30 **Heat exchangers** for heating or cooling liquids and gases used in chemical, pharmaceutical, refining and allied processing industries. Contains cutaway view, sizes, dimensions, weights and materials of construction. 4-p bulletin 1155. Young Radiator Co, Racine, Wisconsin.

31 **G-fin tubes** with longitudinal fins that have 6 to 8 times the exterior surface of same length of bare tubes. Full descriptions of sizes, materials, features in 4-p bulletin 1300. Griscom-Russell Co, Massillon, Ohio.

METERS AND INSTRUMENTS

32 **Electronic pH meter** incorporates an indicating meter of 7-in. scale length that covers entire pH range from 0 to 14 without switching and without reversal of the pointer travel. Illustrated 4-p bulletin 105. Photovolt Corp, 95 Madison Ave, New York 16, New York.

33 **Gas-testing equipment**—including bell provers, flow provers, test meters and flow indicating meters—is described in illustrated 8-p bulletin 1066-S. Meter and Valve Div, Rockwell Manufacturing Co, 400 N Lexington Ave, Pittsburgh 8, Pennsylvania.

MATERIALS HANDLING

34 **Electric chain hoist** is available in capacities from ¼ to 1 ton for operation on 115 v and 208-220/440 v power. Illustrated 12-p bulletin presents full description and specs of *Lodestar* unit. Bulletin 158. Chisholm-Moore Hoist div, Columbus McKinnon Chain Corp, Tonawanda, N. Y.

35 **Electro-magnets** for metal handling jobs in steel mills, foundries, etc. Contains data on welded and bolted units. Photos, capacities, ratings in 24-p bulletin EC-88. Cutler-Hammer, Inc, N 12th St, Milwaukee, Wis.

36 **Industrial casters** and wheels is subject of 20-p bulletin D-339. Selection data, capacities of full line. The Colson Corp, Elyria, Ohio.

37 **Vibratory equipment,** feeders, conveyors, selenium rectifiers and other materials handling equipment. Condensed catalog 554 contains 50-p of technical data, descriptions and photos. Syntron Co, 492 Lexington Ave, Homer City, Pa.

38 **Revolving cranes** have 150-ft ton capacity. Application photos, performance specs and descriptions in 4-p bulletin. R G LeTourneau Inc, Longview, Texas.

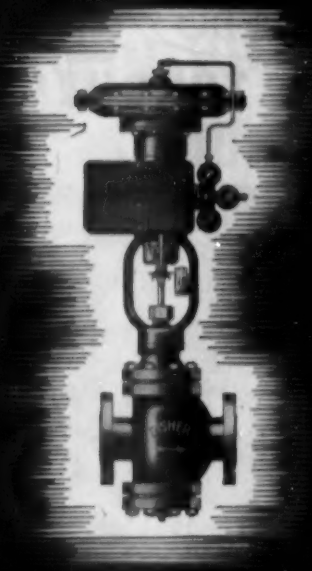
PIPING, VALVES, FITTINGS AND SPECIALTIES

39 **Piping systems** — underground, overhead, prefabricated, insulated viscous liquid systems—described in 4-p illustrated bulletin 6cKa. E B Kaiser Co, Glenview, Illinois.

40 **Tubing and pipe** of corrosion-resistant alloys. Bulletin gives properties, workability, application data, size ranges. 4-p bulletin TD-117. The Carpenter Steel Co, Alloy Tube Div, Union, New Jersey.

41 **"True piping economy"** is subject of 8-p bulletin containing data on economies of wrought iron piping. A M Byers Co, Clark Bldg, Pittsburgh 22, Pennsylvania.

42 **Reducing valve.** Illustrated 4-p bulletin S-731 contains data on recommended uses, construction and operation, capacity, rating and sizing. A W Cash Co, P.O. Box 551, Decatur, Illinois.



THE NAME **FISHER** ON A **DIAPHRAGM MOTOR VALVE**

TELLS YOU THAT IT IS CUSTOM DESIGNED, ENGINEERED AND MANUFACTURED TO FIT YOUR APPLICATION—WITH THE ULTIMATE IN DEPENDABILITY, ECONOMY AND TROUBLE-FREE PERFORMANCE

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

It's Terrific...

the NEW TOLEDO SPIN TORQUE CHUCK

The Perfected Chuck-Locks Tight with a *Spin of the handwheel!*

- No more rocking, socking or hammering with the new "TOLEDO" SPIN TORQUE CHUCK. Now you can chuck ⅛" to 2" pipe, or rod as small as ¼", with a spin of the handwheel. Jaws are flush with chuck—exclusive rocking wedge action of jaws prevents slippage — husky "big hand" grip on wheel is easier to tighten — no end thrust slippage. See them at your pipe tool suppliers, now. Next time try "TOLEDO".

THE TOLEDO PIPE THREADING MACHINE COMPANY
1445 SUMMIT ST., TOLEDO 4, OHIO

BUILDERS OF THE WORLD'S FINEST PIPE TOOLS
TOLEDO
PIPE THREADERS - PIPE WRENCHES - PIPE MACHINES

More FREE BULLETINS

Begins on page 165

43 **Butterfly valves,** tight-closing rubber-seated. Photos, drawings, sizes, pressures, velocities in 4-p bulletin 650-LIA. Builders-Providence, Inc, 345 Harris Ave, Providence, R. I.

44 **Lubricated plug valves,** stem-sealed self-freeing plug. Illustrated 28-p bulletin RB39-5 contains complete engr data, features, capacities and specs. Homestead Valve Manufacturing Co, Coraopolis, Pennsylvania.

45 **Solenoid valves** for flow control of liquids, gases, air and refrigerants. Illustrated 6-p bulletin RS141. A-P Controls Corp, 2460 N 32nd St, Milwaukee, Wisconsin.

WATER TREATMENT

46 **Water - conditioning** equipment and materials is subject of illustrated 20-p bulletin 611B. Contains data on zeolite water softeners, deionizers, boiler and process water conditioning, filters, purifiers, degasitors, chemicals, water softener modernization, and zeolites of all types. Elgin Softener Corp, Elgin, Illinois.

47 **Water system trouble** spots and factors that can produce breakage and failure in components of heaters, boilers, condensers, etc are outlined in 6-p pocket-size booklet. Hall Laboratories, Inc, 323 4th Ave, Pittsburgh 30, Pennsylvania.

48 **Cellte filtration** is subject of illustrated 12-p bulletin PA-51A. Covers filtration of potable water, process water and plant wastes. Johns-Manville, 22 E 40th St, New York 16, New York.

49 **Single-tank deionizer** removes all ionizable impurities — including CO_2 and silica. Illustrated 4-p bulletin 512. Elgin Softener Corp, Elgin, Ill.

PUMPS

50 **Centrifugal pumps** rated from 35 to 4500 gpm, with maximum heads to 195 ft. Data on single-stage, double-suction units in illustrated 6-p bulletin 350 - 53. American - Marsh Pumps, Inc, Battle Creek, Michigan.

51 **Controlled volume pumps** for accurate chemical feed at low cost. Complete data on simplex and duplex models, capacities, pressures, materials, mounting dimensions in 4-p bulletin H20-1. Milton Roy Co, Station H, 1300 E Mermaid Lane, Philadelphia 18, Penn.

MISCELLANEOUS

52 **Moving sidewalks** are described in 4-p bulletin DR-754-10. For use wherever pedestrian traffic is a problem. Hewitt-Robins Inc, Stamford, Connecticut.

53 **Dictionary** of cold-finished steel terms. Includes more than 180 relatively detailed definitions frequently used in purchase, manufacture, treating, machining and finishing of steel. More than 30 photos, curves and tables in 32-p bulletin 6. LaSalle Steel Co, Chicago 80, Illinois.

"Movement Is Life" is the title of a 20-minute 16-mm motion picture sponsored by the Conveyor Equipment Manufacturers Assn. Black-and-white prints may be borrowed from Modern Talking Picture Service, 45 Rockefeller Plaza, New York, N. Y.

Philadelphia Electric Co has announced plans to install a new 175,000-kw electric generating unit at its Schuylkill generating station in Philadelphia.

IMPORTANT SAFETY for your plant!

Slip-resistant

Tri-Lok and Tri-Forged

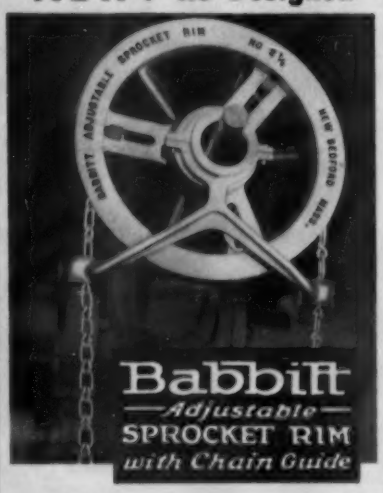
Serrated grating and stair treads

Don't take chances in those plant areas where grease, oil or other conditions make floors slippery and dangerous! Play it safe with the non-skid, notched surface of *Tri-Lok* or *Tri-Forged* serrated grating and stair treads. Here is a walking surface that is hazard-proof and the ultimate in safety. To be sure you have complete information on these and other *Tri-Lok* and *Tri-Forged* products, write today.

For free catalog write Department D-2108

DRAVO
CORPORATION
Pittsburgh 22, Penna.
National Distributors

NEW! Re-Designed



ANY VALVE is readily accessible from *the floor* with low-cost Babbitt Sprocket Rim. Now re-designed for —

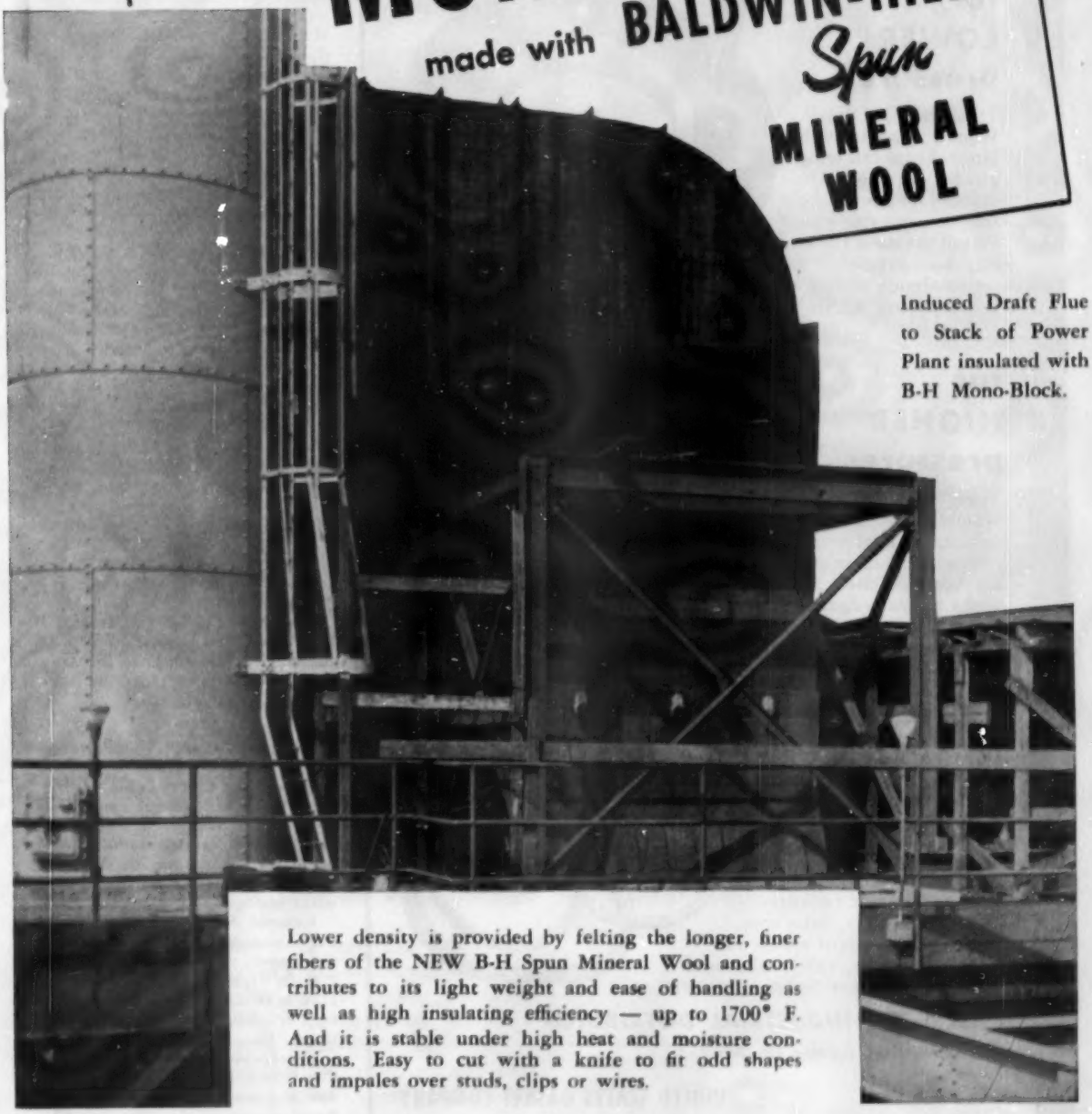
- **Greater strength**
- **Easier, quicker, more solid assembly**

Simplifies pipe layouts, prevents accidents, fits all valve wheels. Your supplier carries complete stocks. Call him — or write for folder and prices.

Babbitt STEAM SPECIALTY CO.
2 BABBITT SQ., NEW BEDFORD, MASS., U.S.A.

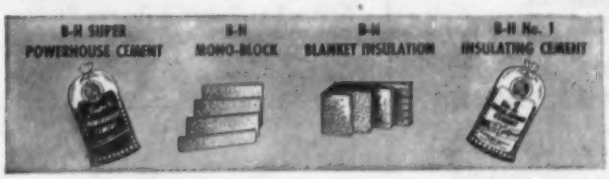
NEW LIGHTWEIGHT MONO-BLOCK

made with BALDWIN-HILL *Spun* MINERAL WOOL



Induced Draft Flue to Stack of Power Plant insulated with B-H Mono-Block.

Lower density is provided by felting the longer, finer fibers of the NEW B-H Spun Mineral Wool and contributes to its light weight and ease of handling as well as high insulating efficiency — up to 1700° F. And it is stable under high heat and moisture conditions. Easy to cut with a knife to fit odd shapes and impales over studs, clips or wires.



BALDWIN-HILL COMPANY

108 Breunig Ave. Trenton 2, N. J.

Kalamazoo, Mich. Huntington, Ind. Temple, Texas

Standardize on AJAX SPIRAL WOUND GASKETS for all steam plant services

for LOWER pressures

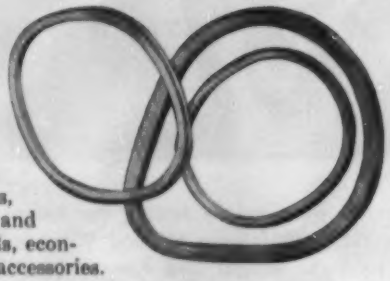
Type "H" Ajax Spiral Wound Gaskets with integral wire centering guide answer the demand for a low-priced self centering ring gasket. Permit the use of the smallest, least-expensive gasket for maximum sealing effect. For pressures up to 600 psi.

for HIGHER pressures

Type "S-R" Ajax Spiral Wound Gaskets with solid metal reinforcing ring which locates gasket inside bolt circle, prevents lateral expansion under pressure and acts as a compression gauge for maximum gasket efficiency. For pressures up to 1500 psi.

for BOILERS and ACCESSORIES

Ajax Spiral Wound Gaskets are offered in all sizes and shapes for manholes, hand holes, tube caps, etc., for all standard makes and models of boilers, water walls, economizers and other boiler accessories.



CALL YOUR INDUSTRIAL DISTRIBUTOR

. . . or write for Catalog No. AG-953.

UNITED STATES GASKET COMPANY
CAMDEN 1 • NEW JERSEY

USG | FABRICATORS OF FLUOROCARBONS & OTHER PLASTICS
Representatives in principal cities throughout the world

APPOINTMENTS

Corporation executive changes

Allis-Chalmers Manufacturing Co: Robert S Stevenson, president. **Canadian Allis-Chalmers Ltd:** Harold M Schudt, president. **The Wm Powell Co:** H James Coombe, chairman of the board and chief executive officer; David M Forker, Jr, president. **Propulsion Research Corp:** A V Finn, president and chairman of the board. **M H Detrick Co:** Louis Ellman, president; J C Wilson and R J Stanley, vice-presidents.

Dresser Industries, Inc: H P Boncher and W D Miller, operating vice-presidents. **Westinghouse Electric Corp:** Chris H Bartlett and Charles C Shutt, vice-presidents. **General Refractories Co:** Drew M Thorpe, executive vice-president; Lee A Diehl, vice-president and controller. **The International Nickel Co of Canada, Ltd:** Ralph D Parker, vice-president. **American Brake Shoe Co:** Harry C Platt, president of Engineered Castings div. **Graybar Electric Co:** Douglas Wallace, vice-president.

National Aluminate Corp: H R Powers, Gage Averill and Alphonso Cantalini, vice-presidents. **The Lummus Co:** James H Curtis, vice-president. **Union Carbide & Carbon Corp:** Howard S Bunn, executive vice-president and member of executive committee; Augustus B Kinzel, vice-president, research. **Harbison-Walker Refractories Co:** A Brent Wilson, vice-president, subsidiaries.

Cummins Engine Co, Inc: E D Tull, executive vice-president; R B Stoner, vice-president, personnel. **Ampco Metal, Inc:** James A Arter, vice-president, manufacturing.

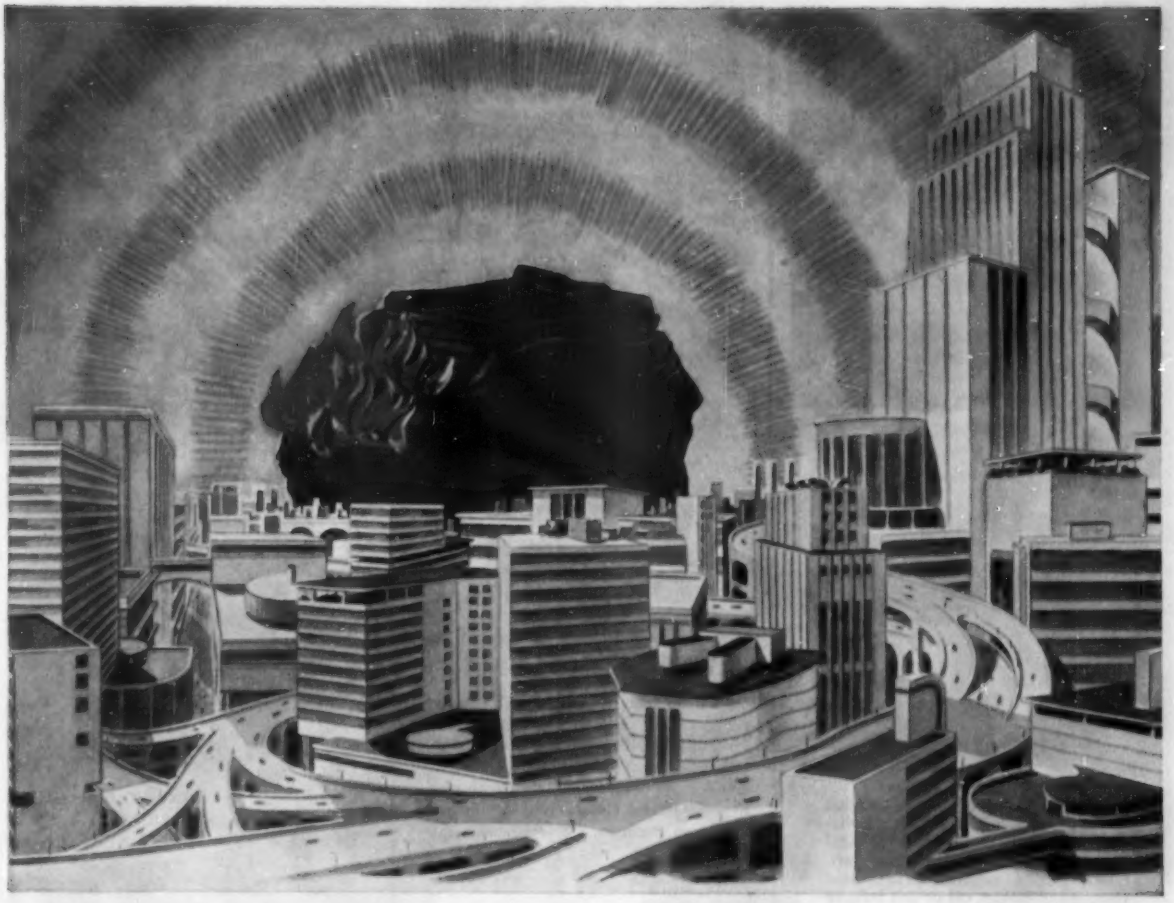
Operations executive changes

American Chain & Cable Co, Inc: H L Cummings, general manager of R-P&C Valve div. **H K Porter Co, Inc:** Julius C Hydrick, works manager of Quaker Rubber Corp div. **Petersen Engineering Co:** Robert W Goode, works manager.

General Electric Co: Robert G Page, manager of Maspeth Plant of distribution assemblies dept; William P Cook, III, manager of wire and cable plant in Oakland. **Dresser Industries, Inc:** F G Fabian, Jr, general manager, Dresser Manufacturing div.

Enterprise Engine & Machinery Co: Gordon P Vega, manager of commercial research. **Syntron Co:** C W Ramaley, manager of rectifier dept. **The Kerite Co:** Robert A Young, Pacific Coast manager. **Leeds & Northrup Co:** Earle D Moiles, Jr: Boston district manager; Paul K Welch, New York district manager. **M H Detrick Co:** C B Edgar, Pittsburgh district manager.

Pacific Power & Light Co: L A Morphey, power section supt for Wash-



The fuel that sparked our nation's growth secures her greater future

A young America—primed by a new and power-packed fuel—became a great industrial giant almost overnight. Coal had supplied the first unwavering spark which was to grow into the brightest productive flame the world has ever known.

After being served so well in the past and present, America looks again to dynamic coal for greater prosperity and security in the future. The vast Bituminous fields along the Baltimore & Ohio contain excellent coals in wide variety—available for centuries to come.

Highly mechanized mines, equipped and ready for any demands, will help maintain long-range cost stability. And improved utilization methods will meet the increased requirements of the future by providing greater coal-burning efficiency.

CALL ON OUR COAL TECHNICAL SERVICE

You'll receive complete information from trained B&O experts about the kind and size of Bituminous coal that fits your needs best—at a price you want to pay. Write:

COAL TRAFFIC DEPARTMENT
BALTIMORE & OHIO RAILROAD
BALTIMORE 1, MARYLAND

BITUMINOUS COALS FOR EVERY PURPOSE

Baltimore & Ohio Railroad

Constantly *doing things* — better!

Low Cost Automatic Sequence Control Assures Proper Draft for Efficient Combustion *with* CLEVELAND DAMPER CONTROL

Open View
Closed View

Cleveland Damper Controls provide in one compact cabinet all the elements for safe, automatic, electrical remote control from over-fire draft. CFE Damper Controls prevent heat from your stoker, oil or gas burner from rushing out the stack—keeps it in the boiler where it belongs—gives you the most for your fuel dollar.

CFE Damper Control with Automatic Sequence Feature:

Cuts Fuel Costs – Quickly pays for itself in fuel savings.

Reduces Smoke, Soot, Fly Ash – by maintaining proper draft and timing, both essential to efficient combustion.

Prolongs Boiler Life – prevents overheated combustion chambers, flue fires, "puff-backs" and their subsequent damage to boiler equipment – lengthens life of refractories – reduces maintenance.

Increases Safety – boiler operations are mechanical – fire hazard and danger to personnel are minimized. Optional features include: Models with Starting Draft Selector, Minimum Draft Safety Switch and Post Purge, in addition to models for Positive Pressure Control.

For complete details on how CFE Damper Controls can cut costs and increase boiler efficiency, write to:

CLEVELAND FUEL EQUIPMENT CO.
1111 Brookpark Rd., Cleveland 9, Ohio
In CANADA, write to:
Onter Laboratories Ltd., 111 Tycos Drive, Toronto

More APPOINTMENTS

Begins on page 220

ington and Oregon properties; George Nostrant, asst general supt. **Public Service Co of New Mexico:** Elmer L Kaemper, manager of Las Vegas div; Robert B Rountree, manager of Belen div; Vernon Easley; general supt of Albuquerque div. **The Ironton Fire Brick Co:** L C Hewitt, director of research. **Kuhlman Electric Co:** William T Sackett, Jr, manager of research.

Engineer changes

The Kuljian Corp: Hilton A Levonian, vice-president in charge of consulting engineering. **Minneapolis-Honeywell Regulator Co,** Brown Instrument div: John M Wilson, chief engineer of development and design div of engineering dept. **Alco Products, Inc:** John F Haines, chief development engineer, atomic products.

North Electric Manufacturing Co: Williard A Roberts, senior project engineer in charge of mechanical and electro-mechanical design. **The Lincoln Electric Co:** Norman J Hoenie, chief engineer, machine div; Emmett Smith, chief engineer, electrode div. **Hoffman Laboratories, Inc:** Leonard A Mayberry, engineering manager; Gene Lamphear, chief electrical engineer. **Bechtel Corp:** John P Buehler, executive engineer.

New names

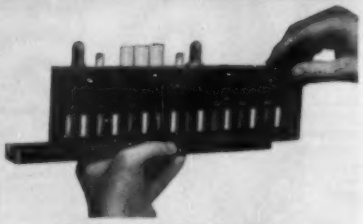
Alco Products, Inc, formerly known as American Locomotive Co. **Astubeco, Inc,** 53 Park Pl, New York 7, N. Y., formed as a distributor of boiler tubes, welding fittings and flanges, stainless tubing, pipe and fittings. **Pennsylvania Fluoro Plastic Co,** 1115 N 38th St, Philadelphia 4, Pa, formed to manufacture *Teflon* tubing products.

Institute, association changes

Heating & Cooling Coil Manufacturers Assn: W C Jones, president; L A Childs, vice-president; G W McCormick, Jr, secretary-treasurer. **Industrial Research Institute, Inc:** E Duer Reeves, president. **Michigan Engineering Society;** Samuel D Porter, president; M Eugene Malone, vice-president; D Bradford Apted, secretary; and George M Foster, treasurer. **National Electrical Manufacturers Assn:** Joseph F Miller, managing director. **Cleveland Technical Societies Council:** Clarence J Beller, president. **Scientific Apparatus Makers Assn:** Henry F Dever, president.

Addition of 10,000 sq ft to its present manufacturing facilities has been completed by Hoffman Engineering Corp, Anoka, Minnesota.

TEST
pH, PHOSPHATE
ON THE SPOT
with
TAYLOR COMPARATORS



GET ACCURATE BOILER WATER TESTS *In 3 Easy Steps!*

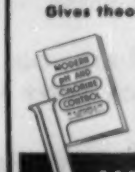
For pH, place your sample right in the comparator tubes . . . add indicator to middle tube only . . . move the color standard slide across until colors match, and read result direct. That's all there is to it. Phosphate and nitrate determinations are just as easy.

Also, *Taylor Total Hardness Set* lets you determine hardness with ease and accuracy of an alkalinity titration.

COLOR STANDARDS GUARANTEED

Taylor liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy. Each complete set of standards is mounted in a lightweight, durable plastic slide . . . no single standards to handle.

SEE YOUR DEALER for Taylor sets or write direct for FREE HANDBOOK, "Modern pH & Chlorine Control." Gives theory and application of pH control, illustrates and describes full Taylor line.



SERVING SCIENCE AND INDUSTRY 1930 1955 FOR 25 YEARS

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

Hardened, Honed Seats

for tough throttling service

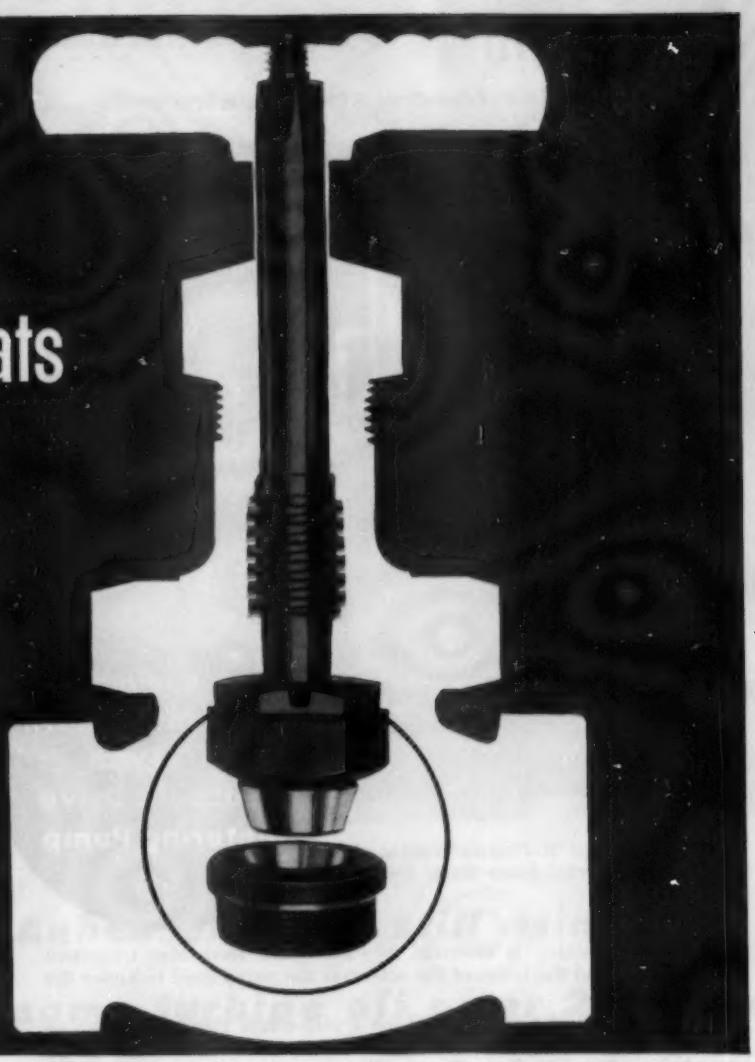


Fig. No. 558, bronze globe valve, 200 lbs. WSP, @ 550°F., 400 lbs. WOG, non-shock

A plug-disc and seat so hard they can crush scale between them and still close tight. A stem that absolutely will not gall or seize. The combination is in a rugged bronze valve designed for tough throttling service . . . the OIC 558!

Both plug-disc and seat are stainless steel, heat-treated to more than 500 Brinell hardness. Their seating surfaces are ground and *honed* to an accurate, smooth, bearing finish. The stem is OIC *alloy-40*, a sturdy bronze which won't gall or seize.

Remember, in throttling service a valve's stem, plug-disc and seat must withstand the most abusive wear. Rely on the toughness designed into this OIC line to give you extra-long service. Specify the modern 558 where you need bronze globe valves for throttling.

Write for Form No. 1001 which describes this valve along with the entire OIC 500 line, including composition disc and spherical disc globes, angles and check valves.

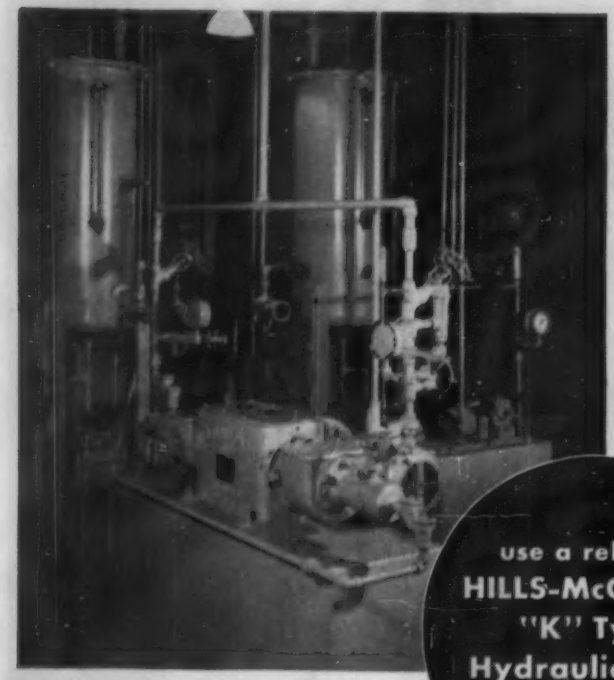
Call your OIC Distributor.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

P-507

VALVES | **FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES**

HERE'S HOW to take the headaches out of boiler feedwater treatment



use a reliable HILLS-McCANNA "K" Type Hydraulic Drive Metering Pump

Two-feed Type "K-3" pump handling phosphate in internal boiler water treatment.

Dependability is essential in your boiler feedwater treatment set-up. And the heart of the set-up is the pump used to meter the treatment.

The Hills-McCanna "K" Type Pump offers standards of accuracy, dependability and freedom from maintenance never possible before. The "K" Type Pump utilizes a unique hydraulic drive in which the drive parts operate in an oil bath. Stroke is adjustable while the pump is in operation; control is accurate; automatic pressure relief is built in.

Ordinary pump problems such as exposed linkage . . . linkage lubrication . . . atmospheric conditions . . . vertical type liquid ends . . . linkage and drive misalignment are eliminated by the "K" pump's fully enclosed, in-line construction.

Hills-McCanna "K" Type Pumps are available in two styles, the "K-2" with ¾ H.P. motor for maximum capacities from 2 to 135 gph per feed and the "K-3" with a 3 H.P. motor for maximum capacities from 1.6 to 730 gph per feed. The "K-2" develops pressures to 10,000 psi, the "K-3" to 30,000 psi. One and two feed units are available.

For further information ask for Bulletin KP-54 or send an outline of your requirements. HILLS-McCANNA CO., 2369 W. Nelson St., Chicago 18, Illinois.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • LIGHT ALLOY CASTINGS

REPORTS from the FIELD

Begins on page 150

Lake Maracaibo, Venezuela, will have the most powerful concentration of gas turbines in the world when completed.

Twelve 7000 hp Westinghouse combustion gas turbines with a total maximum rating of 96,000 hp will be installed on the plant's over-water platform. They will drive centrifugal compressors that will put natural gas derived from oil operations under high pressure, then inject it into a 10,000 acre deposit extending beneath the lake.

The plant will put 300,000,000 cu ft of gas back into the earth daily. It will also enable Creole Petroleum Corp to recover considerably more oil from one of its major deposits.

The new plant will receive natural gas from 18 miles away. It will flow through more than a dozen 30-in. lines laid along the lake bed. It will leave the compressors through four 10-in. injection lines.

The gas turbines themselves will burn 26,000,000 cu ft of the gas daily and will operate in two "strings" of six units.

Conveyor belt sets record for tonnage hauled

► WORLD'S RECORD FOR tonnage hauled by a conveyor belt is held by a ¼-mile long belt in the Andes Mountains at Chuquicamata, Chile. Built by U.S. Rubber Co in 1939, the 60-in. wide belt carried 131-million tons of copper ore for the Chile Exploration Co at a cost of 36c per 1000 tons before it was retired from service recently. The belt was specially made to resist the strong rays of the sun at 10,000-ft elevation.

Announce revision of manual on 85% magnesia insulation

► REVISION OF THE "85% Magnesia Insulation Manual" with 80 pages of text, illustrations and tables has been completed by The Magnesia Insulation Manufacturers Assn. The first edition was published in 1949. Revised second edition offers new engineering and product data. Copies are available to those concerned with heat insulation by writing the Association at 1317 F St, NW.

E. A. Hamann (left), Power Generation Engineer and Robert Best (right), Superintendent of Utilities, go over lubrication records with Bill Schall, Standard Oil lubrication specialist. Bill Schall has been providing technical sales service to Standard Oil customers since 1943. Bill is an engineer with a B.S. in engineering from Georgia Tech., and a graduate of Standard's Sales Engineering School. Customers of Bill's find this experience and background pay off *for them.*

Anheuser-Busch still using same turbine oil after 24 years

. . . NONPAREIL

For more than 24 years the Anheuser Busch Brewery, St. Louis, Mo., has been operating two 3,000 kw., turbines using NONPAREIL Turbine Oil. Three more turbines added to the system in 1940, '48 and '51 have also used NONPAREIL since beginning operations. The reason for choosing NONPAREIL is clear; it is guaranteed for the life of the turbine.

Since the initial installation, Anheuser Busch has not had to replace a NONPAREIL Turbine Oil fill. Neutralization number is always far below 0.15 mg. KOH/g., the degree of acidity Standard Oil guarantees NONPAREIL will not exceed. At nearly all times neutralization number is on the order of 0.03 mg. KOH/g. (See chart).

In all these years, oil systems have remained clean. There has been no problem of oil acidity in any of the five turbines. The delicate art of brewing world famous Budweiser goes on without concern over power failure due to lubrication failure.

Like to know more about NONPAREIL and its possible use in your turbines? In the midwest call your nearby Standard Oil lubrication specialist. Or, contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Anheuser-Busch Turbine Lubrication Record

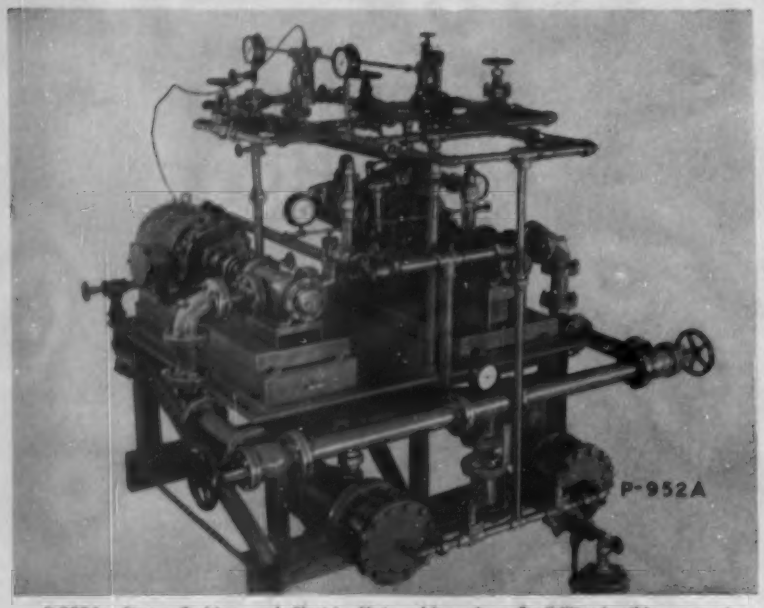
Generator Capacity	Start up and NONPAREIL Installation Date	Date of Last Oil Analysis	Neutralization Number
3,000 kw.	Oct. 2, 1930	July 20, 1954	0.03
3,000 kw.	Oct. 2, 1930	July 22, 1954	0.02
2,500 kw.	June 10, 1940	July 20, 1954	0.03
7,500 kw.	Jan. 2, 1948	July 22, 1954	0.03
7,500 kw.	July 26, 1951	July 22, 1954	0.01

STANDARD

STANDARD OIL COMPANY
(Indiana)

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER..



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-E52H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40 — very interesting and informative.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

REPORTS from the FIELD

Begins on page 150

Washington 4, D.C., stating company and title.

The new edition of the manual contains explanations of chemical and physical properties of 85% magnesia, together with new conductivity density and fire-resistance data. The water-resistant magnesia insulation for underground conduits and other locations subject to flooding or excessive moisture is described. A section is devoted to recommended application techniques for hot piping and equipment.

Tables include simplified thicknesses to which 85% magnesia and diatomaceous silica pipe insulation are manufactured, replacing obsolete thicknesses such as "standard." Nominal and actual thicknesses are given for pipe sizes up to 24 inches.

Calendar of Events

Aug 15-18—American Institute of Electrical Engineers, Pacific general meeting. Finlen Hotel, Butte, Montana. Information from AIEE, 33 W 39th St, New York 18, New York.

Aug 22-23—"Electronics and Automatic Production," national symposium. Sheraton-Palace Hotel, San Francisco, Calif. Complete information from National Industrial Conference Board, 247 Park Ave, New York, N. Y., or Stanford Research Institute, Palo Alto, California.

Sept 12-14—American Institute of Electrical Engineers, 2nd electrical conference of the petroleum industry. Shamrock Hotel, Houston, Texas. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Sept 12-16—Instrument Society of America, 10th annual instrument conference and exhibit. Shrine Exposition Hall and Auditorium, Los Angeles, Calif. Complete information from ISA, 3443 S Hill St, Los Angeles 7, California.

Sept 26-30—Atomic Industrial Forum, 1st trade fair of atomic industry. Sheraton-Park Hotel, Washington, D.C. Details from AIF, 260 Madison Ave, New York 16, New York.

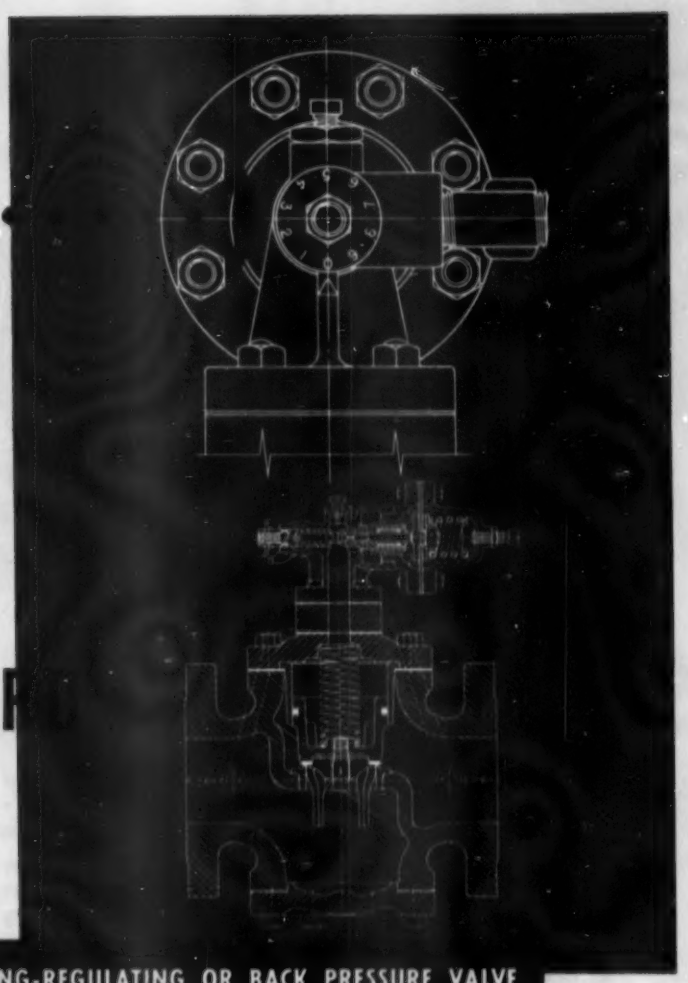
Oct 3-5—National Electronic Conference, 11th annual meeting. Hotel Sherman, Chicago, Ill. Details from J Kocik, c/o Illinois Bell Telephone Co, 208 W Washington St, Room 300, Chicago 6, Illinois.

Oct 3-7—American Institute of Electrical Engineers, fall general meeting. Morrison Hotel, Chicago. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 17-19 — Engineer's Society of Western Pennsylvania, 16th annual water conference. Hotel William Penn,

FOR EXCEPTIONAL CONTROL

a pilot-operated valve with adjustable throttling range



the NEW Improved

CASH STANDARD

TYPE 10 VALVE

- SELF-CONTAINED
- SINGLE SEAT—tight closure
- LARGE CAPACITY

SERVES AS PRESSURE REDUCING-REGULATING OR BACK PRESSURE VALVE

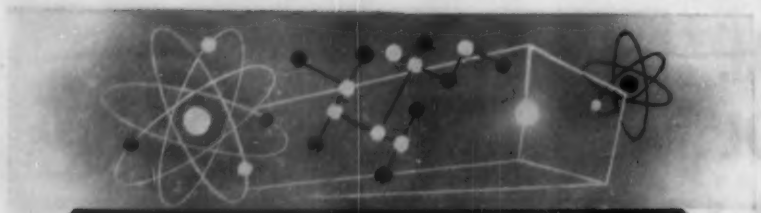
- Improved Y-type strainer in pilot control line protects pilot.
- Simple dial-type range selector permits selection of throttling range required for the most stable and sensitive control.
- Switching control piping easily converts valve from pressure reducing to back pressure operation.
- Diaphragm assembly easily changed to convert to different pressure range.
- Packless design results in low friction and high sensitivity.
- Recommended for: water systems, altitude control, as an unloading valve on extrusion presses, back pressure control, oil refineries.
- For use with water, gas, air, light oils, refrigerants (ammonia, freon).
- Materials: iron, bronze or steel body; bronze or stainless steel trim; monel trim on pilot valve. Composition or metal seat.
- Sizes: 2" to 3" with screwed ends.
  2" to 12" with flanged ends.

WRITE TODAY FOR COMPLETE INFORMATION AND LITERATURE

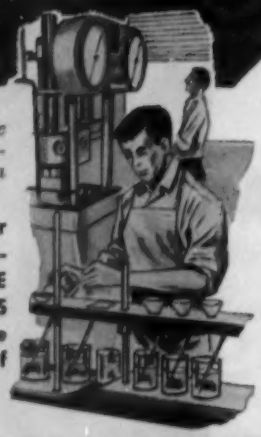
CASH STANDARD

A. W. CASH COMPANY • P.O. BOX 551, DECATUR, ILL.

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS



CHAMPION
brings you the
WELDING ELECTRODES
of the Future . . . TODAY!!



Whatever your requirements in an arc welding electrode, CHAMPION'S Research and Engineering have designed a product that is tops in its class.

All CHAMPION ELECTRODES, whether MILD STEEL • IRON POWDER CONTACT • LOW ALLOY - HIGH TENSILE • LOW HYDROGEN • STAINLESS STEEL or HARD SURFACING have built in quality and excellence of performance.

We are especially proud in bringing to the fabricator **CHAMPION CROLOY ELECTRODES** which greatly minimize all of the problems formerly encountered in welding of chrome-moly steels. They offer —

Exceptional ease of handling in all positions. Highest possible mechanical properties; both as welded and stress relieved. Pass the most rigid radiographic examination. Reduce the former rigid restrictions on pre-heat and post-heat.

Header tee connections

For the full story on **CHAMPION CROLOY** or any of the other outstanding **CHAMPION ELECTRODES** mail your letterhead request at once to Dept.

THE CHAMPION RIVET COMPANY
CLEVELAND 5, OHIO — EAST CHICAGO, INDIANA

REPORTS from the FIELD

Begins on page 150

Pittsburgh, Pa. For details address the Society Office, Hotel William Penn, Pittsburgh 30, Pennsylvania.

Oct 17-21—National Safety Council, 43rd national safety congress and exposition. Conrad Hilton, Congress, Morrison and LaSalle Hotels, Chicago, Ill. Further information from R L Forney, National Safety Council, 425 N Michigan Ave, Chicago 11, Illinois.

Oct 24-25—Steel Founders' Society of America, fall meeting. The Greenbrier, White Sulphur Springs, W. Va. Details from SFSA, 920 Midland Bldg, Cleveland 15, Ohio.

Detroit Edison Co orders 360,000-kva transformer

► WORLD'S LARGEST TRANSFORMER, a 360,000-kva unit, has been ordered from the Westinghouse Electric Corp. The 3-phase, forced-oil-to-air cooled unit will be installed in connection with Detroit Edison Co's new 300,000-kw turbine generator set at their River Rouge Plant and will step up its voltage from 17.3-kv to the 129-kv transmission voltage.

The most powerful transformers previously ordered were two 315,000-kva Westinghouse units that will be installed at River Rouge this summer.

The 360,000-kva transformer will be only slightly larger than the 315,000-kva units and will be shipped upright in one piece, less coolers and bushings. Completion is scheduled for late 1956.

Preliminary program established for solar energy symposium

► A PRELIMINARY PROGRAM has been established for the World Symposium on Applied Solar Energy to be held at the Westward Ho Hotel, Phoenix, Ariz., next November 1 through 5.

Designed for interests of both science and industry, the program and work sessions of a more technical nature are expected to attract attendance in excess of 800 throughout the world. Sponsors of the meeting are the Association for Applied Solar Energy, Stanford Research Institute and the University of Arizona.

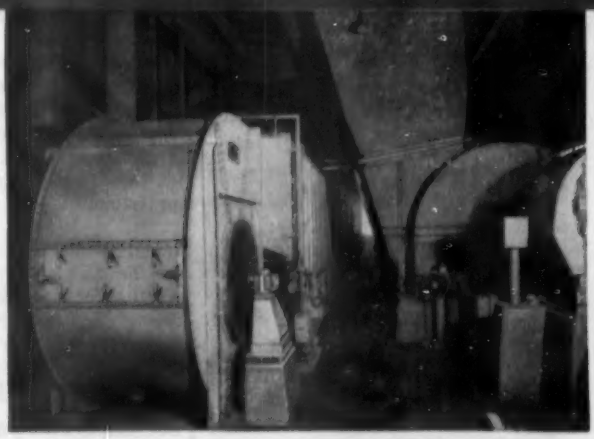
Among papers scheduled by noted authorities on solar energy are: "The Sun's Energy," Dr Farrington Daniels; "Survey of the Domestic Uses of Solar Energy," Dr H C Hottel; and "Space Cooling With Solar Energy," Dr George O G Lof.

Contributions from abroad will be made by Prof Felix Trombe, France, "High-Temperature Furnaces"; R N Morse, Australia, "Solar Water Heat-

INSTANT REPLY TO THE CALL FOR KILOWATTS

SPECIFY DRAFT BY "BUFFALO"

Ever since draft became "mechanized", vital utility stations and plant boiler rooms have been relying on "Buffalo" Draft Fans for that immediate, comforting response to load demands. We've always concentrated on building exceptional long life and reliability into these fans, too, because we know this makes for better and cheaper power production. We call it the "Q" Factor*. It will pay you to write for Bulletin 3750 and see the efficiency, durability and serviceability built into these fans.



*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

Buffalo

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Gate Hoists

FOR ANY SIZE POWER DAM

When you plan power dam gate hoists ask us about designs and patterns that may help you.

Designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist, MURCO Gate Hoists have behind them over seventy years of designing and building experience. During that time we have developed many designs and patterns. In planning gates and gate hoists, we suggest you write us before your overall plans are complete . . . it may save you time and money. We may have designs and patterns to fit your special requirements.

Write for complete information and Engineering Department recommendations to meet your specific power dam requirements.

MURCO

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883

WAUSAU · WISCONSIN

REPORTS from the FIELD

Begins on page 150

ers"; and Dr Hiroshi Tamiya, Japan, "Chlorella for Food."

Special work sessions are being planned with emphasis on technical phases on solar energy utilization. Volunteer papers will be invited.

Headquarters for the symposium during its planning phase is suite 204, Mayer-Heard Bldg, Phoenix, Ariz.

Large industrial power plant to use fluid coke for fuel

► THE NEW 130,000-BARREL Delaware refinery of Tide Water Association Oil Co, will be the first large industrial power plant to use fluid coke. The product is a by-product of a refining process recently introduced by Esso Research and Engineering Co.

Steam will be generated by three fluid coke fired units, to be built by Riley Stoker Corp. Each unit will have a rated capacity of 500,000 lbs of steam per hr at temperatures of 950 F and at 1425 psig.

C F Braun & Co is the consulting engineer for the new plant which is expected to be on stream in late 1956.

Graver offers flow diagrams for water treatment equipment

► PERMANENT FLOW DIAGRAMS designed to increase operating convenience of water treatment equipment are available from Graver Water Conditioning Co. These diagrams are made of specially laminated durable plastic, can be easily cleaned and will maintain their appearance indefinitely. The flow diagram, that can incorporate a complete layout of equipment, is reproduced on the plastic by a photographic process.

Mounted near central control for easy accessibility, it will give the operator a quick, complete picture of equipment operation and will spot any valves not centrally located. Easily removable notations or instructions can be made on the diagram with marking pencil. For further information, contact Graver Water Conditioning Co, 216 W 14th St, New York 11, N. Y.

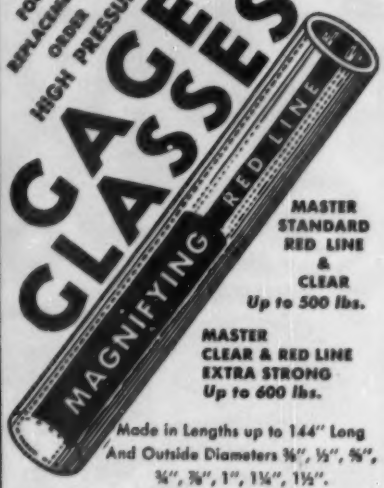
Alcoa installs widest aluminum hot sheet rolling mill

► WIDEST hot sheet rolling mill ever built for the aluminum industry will be installed at the Davenport works of the Aluminum Co of America.

According to works manager E B Fassel, the 160-in. wide hot mill will add an estimated 725 persons to works' employment rolls when it's in full operation two years hence. It will permit use of

FOR REPLACEMENTS ORDER HIGH PRESSURE

GAGE GLASSES



MASTER STANDARD RED LINE & CLEAR
Up to 500 lbs.

MASTER CLEAR & RED LINE EXTRA STRONG
Up to 600 lbs.

Made in Lengths up to 144" Long
And Outside Diameters ⅜", ½", ⅝", ¾", ⅞", 1", 1¼", 1½".

High Pressure Composition

ERNST RUBBER GASKETS

All sizes to fit your gages and valves

FIG. 21—Lip Mold

FIG. 22—Standard

ERNST WATER COLUMN & GAGE CO.

Send for Catalog — LIVINGSTON, N. J.

PERSONNEL MANAGERS

LOOKING FOR ENGINEERS . . . TECHNICIANS?

Write for free copy of

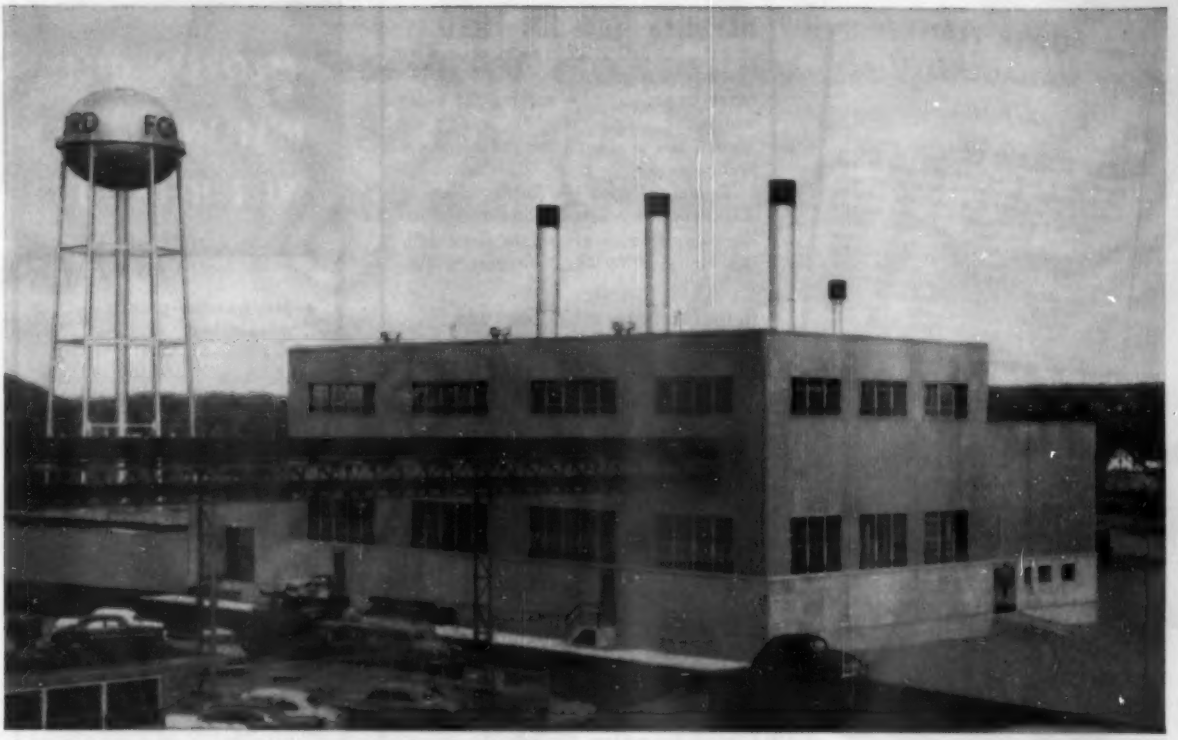
"RESERVOIR OF ENGINEERS AND TECHNICAL MEN"

The engineers and technicians you want to reach are gathered in convenient, compact groups—as this 12-page booklet points out.

It keys the job titles these men hold to the McGraw-Hill publications they read for on-the-job information. It explains how you can make contact . . . channel, concentrate your employment advertising to just the men with the job qualifications you want.

Write for your free copy to

Classified Advertising Division
POWER
330 W. 42nd St., N. Y. 36, N. Y.



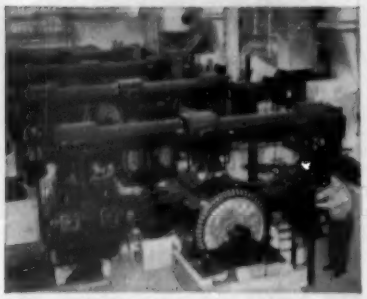
How Ford beat the construction *squeeze* at Mahwah

Steam and air flow from this boiler-compressor building to meet production demands of Ford Motor Company's largest automobile assembly plant at Mahwah, New Jersey. Completed in 13 months, a safe margin ahead of the main assembly plant, it is a good example of how Dravo's "complete package" construction service can work for you.

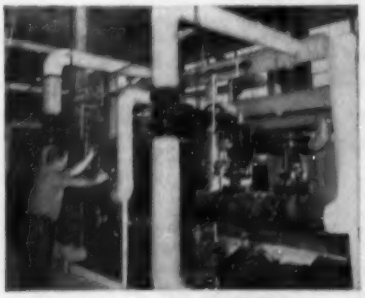
When Ford engineers planned their mammoth new automobile assembly facility, they decided to minimize delay in putting the multi-million dollar plant in operation by taking full advantage of outside services. Dravo's power plant construction specialists were called upon to handle the construction-engineering and construction of the boiler-compressor house. Working as a team, Ford specified the steam and air needed and left the construction planning and erection of the facility up to Dravo.

As a result of this teamwork, all material and equipment was on order within a month, field work started in three months and initial boiler operation in 13 months. The complete plant contains three 132,000 lb/hr boilers and four 2400 cfm air compressors—all conveniently arranged on one operating level with centralized control.

You, too, can profit through Dravo's single-contract responsibility, ranging over all types of jobs from power plant construction to the installation of a pump. Write for complete information and Bulletin No. 1300.



Four air compressors supply the Ford assembly plant with 9,600 cu ft of air per minute.



Power piping for the boilers at Ford's Mahwah assembly plant was fabricated at Dravo's Marietta, Ohio, plant for erection on the site.

DRAVO
CORPORATION
Fifth and Liberty Avenues, Pittsburgh 22, Pa.

POWER PLANT MANAGEMENT

Just Published!

This practical guide makes plain the techniques management must need to run a power plant smoothly and efficiently to put out dependable power at lowest practical cost. Covers a wide range of topics, from the purchasing and use of equipment, and its safe and efficient operation, to the hiring, training, and supervision of operators. Shows how to correlate and weigh objectives, costs, and equipment characteristics to determine best courses of action. Includes yardsticks for measuring effectiveness of management and supervision. By R. H. Emerick, Consulting Mech. Eng., 320 pp., 74 illus., $6.50

INDUSTRIAL POWER SYSTEMS HANDBOOK

Just Published!

Compiled by a staff of experts at General Electric, this comprehensive reference book explains up-to-date industrial power system engineering practices for engineers, technicians, plant managers, and all concerned with the planning and maintenance of electrical facilities for industrial plants or commercial buildings. Gives a wealth of examples and includes a wide range of design data, largely from the experience of General Electric, presented in a simple, practical manner. By Donald L. Beaman, Mgr., Ind. Power Sec., General Electric Co. 830 pp., 916 illus., $12.50

AUTOMATIC CONTROL OF HEATING AND AIR CONDITIONING

A practical view of the working and application of just those automatic controls used in the heating, ventilating, and air-conditioning field. Covers electric and pneumatic control of domestic heating unit heaters and ventilators, commercial heating, cooling, and refrigeration systems, and radiant panel heating. By John E. Haines, Vice-Pres., Minneapolis-Honeywell Regulator Co. 384 pp., 300 illus., $6.75

WATER CONDITIONING FOR INDUSTRY

Describes various types of conditioning apparatus in detail, including design features, control requirements, cost of installation and operation, and gives technical data needed for selecting and applying best processes for particular industrial needs. Covers such problems as corrosion control, boiler steel embrittlement, and steam quality which depend on water quality for correction. Emphasizes water treatment for high-pressure boilers, testing, and interpretation of test data. By S. T. Powell, Cons. Eng., 328 pp., 211 illus., $9.00

READ THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co.
Att. H. W. Bubrow
Industrial and Business Book Dept.
327 W. 41st St., N.Y.C. 36

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

☐ Emerick—Power Plant Mgt.—$6.50
☐ Beaman—Industrial Power Systems Hbk.—$12.50
☐ Haines—Automatic Control of Heating and Air Conditioning—$6.75
☐ Powell—Water Conditioning for Ind.—$9.00

(Print)
Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position .....

For price and terms outside U.S., write McGraw-Hill Int'l., NYC

P-8

REPORTS from the FIELD

Begins on page 150

much larger ingot for making the wider widths of aluminum sheet and plate needed for modern transportation and architecture.

This installation is a further phase in Alcoa's three-year-old defense-supporting expansion of aluminum sheet rolling facilities at the Davenport works.

Manufacturers make package boiler sales agreement

► SPRINGFIELD BOILER CO has made an agreement with the Kewanee-Ross Corp, a division of American Radiator and Standard Sanitary Corp, to market Springfield package boilers for oil, gas and solid fuels. Kewanee-Ross will sell the package units under the name of Kewanee-Springfield water tube package generators.

Springfield will continue to sell the larger custom built and standard water tube field-erected boilers through its own sales organization.

Announce availability of list of American Standards

►NEW 48-PAGE PUBLICATION lists and indexes about 1500 American Standards. Included are 210 for construction and civil engineering, 153 mechanical, 272 electrical, 158 safety, 165 textiles and wearing apparel, 251 photography and motion pictures, 74 petroleum products, 69 chemical, 62 metallurgy, 38 gas-burning appliances, 32 drawings, letter symbols and abbreviations, 18 mining, 11 rubber and a miscellany of others.

The booklet is available free from the American Standards Association, 70 E 45th St, New York 17, N. Y.

Plans for erection of 63,000 sq ft of additional manufacturing floor space to the Atlantic Plant of U.S. Electrical Motors Inc have been announced. The plant will have approximately 200,000 sq ft of floor space upon completion of the project.

"Compressed Air Power" is the subject of a 16-mm, 17-minute sound color motion picture, available through purchase from the Educational Committee of Compressed Air and Gas Institute, 1410 Terminal Tower, Cleveland, Ohio. The film was produced particularly as an engineering teaching aid.

A contract signed for installation of a 200,000 kw steam electric generating unit will help Niagara Mohawk Power Corp provide a total of 3,100,000 kw. Stone and Webster, Inc will install the unit at Niagara's Huntley station near Tonawanda, N. Y. It will give the Huntley station a total capacity of 1,050,000 kw, making it one of the largest generating stations now in operation in the U.S.

McGRAW-HILL MAILING LISTS WILL HELP YOU

- Merchandise your advertising
- Conduct Surveys
- Get leads for your salesmen
- Get inquiries about your product or service
- Pin-point geographical or functional groups
- Sell Direct
- Build up weak territories
- Aid Dealer Relations

Direct Mail is a necessary supplement to a well rounded Business Paper Advertising program.

600,00 actual names of the top buying influences in all the fields covered by the McGraw-Hill publications make up our 150 mailing lists. These lists are built and maintained primarily for our own use, but they are available to you for Direct Mail purposes. Pick out a list of YOUR prospect from our Industrial Direct Mail Catalogue.

More and more, progressive companies are using Industrial Direct Mail regularly as an advertising medium. They effectively allocate a portion of their concentrate on the best business publication.

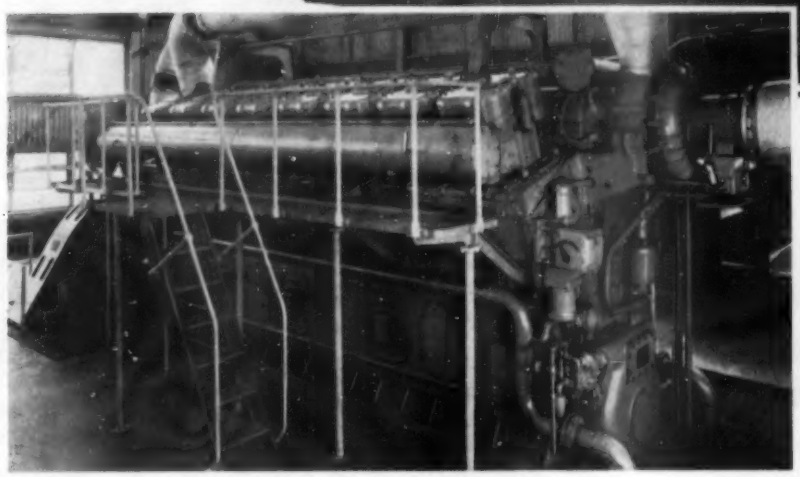
For complete, detailed information about our service, fill in the coupon or write for your copy of our free Business and Industrial Direct Mail catalogue.

Direct Mail Division,
McGraw-Hill Publishing Co., Inc.
330 West 42nd St., N. Y. 36, N. Y.

Please forward my free copy of the McGraw-Hill "Industrial Direct Mail Catalogue."

Name _____
Company _____
Address _____
City _____ State _____

Cooper-Bessemer Flexibility Helps M & A Green Forest Plant Win "Top-Rated" Honors



Another Example of Efficient Power at Lower Cost

Here's one of the four Cooper-Bessemer LSV's that furnish dependable, low cost power in M & A's award winning Green Forest Plant.

• FOR THE FOURTH SUCCESSIVE YEAR the Diesel Progress annual award for the most efficiently operated REA internal combustion plant goes to a Cooper-Bessemer powered station . . . M & A Electric Power Cooperative's Green Forest Plant near Poplar Bluff, Missouri.

Here, four 16-cylinder Cooper-Bessemer LSV engines, each rated 3300 hp at 327 rpm, helped win the coveted bronze plaque by producing 58,945,000 kw. hours at a net cost of only 6.41 mills per kilowatt hour.

Even with varying combinations of fuel, and changing power load demands, these Cooper-Bessemer engines offer reliable performance and long-lasting economy. In part, this is done through automatic controls, utilized to quickly, economically convert from gas-diesel to oil-diesel in the event of low gas pressure, and back again to gas-diesel when normal pressure is restored.

Another feature of the M & A plant is the compact design of the Cooper-Bessemer V-type engines. *More* power can be concentrated per square foot of floor space for less extensive, less expensive engine foundations. For further information on heavy-duty Gas-Diesel, Diesel or Gas engines, contact the nearest Cooper-Bessemer office.

MOUNT VERNON, OHIO
COOPER-BESSEMER
GROVE CITY, PENNA.

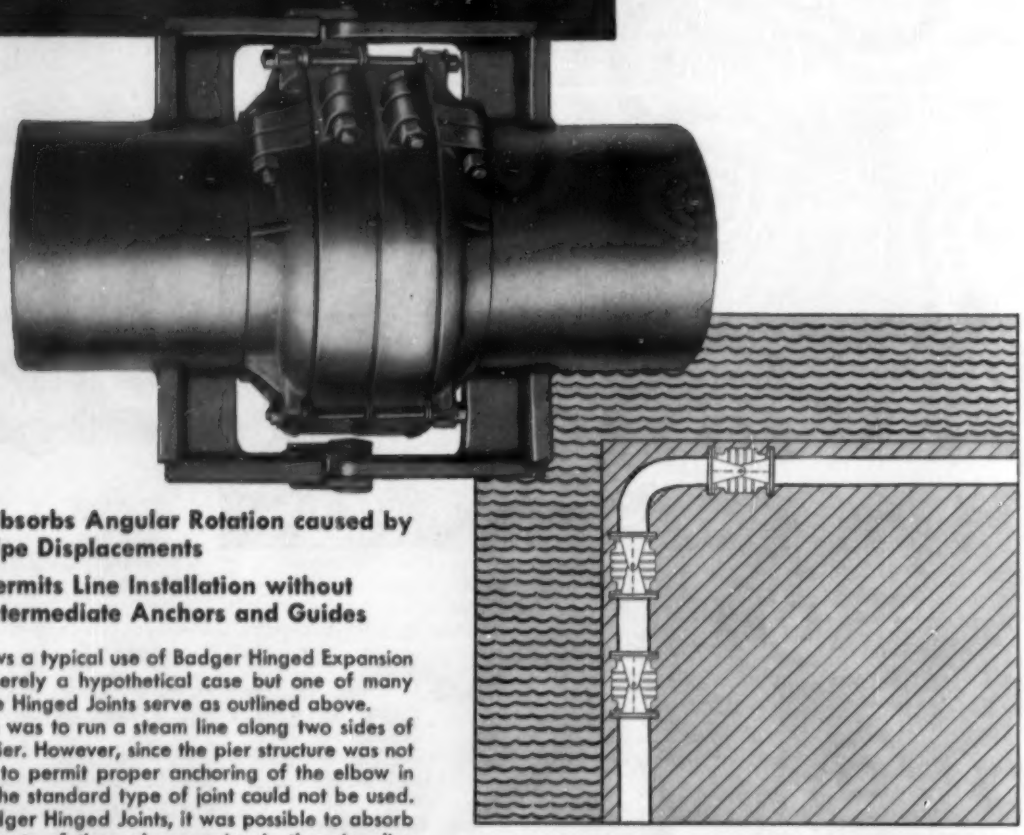
New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

BADGER

EXPANSION JOINTS

Typifying Expansion Joint Engineering At its Best

THE *Hinged* EXPANSION JOINT



- **Absorbs Angular Rotation caused by Pipe Displacements**
- **Permits Line Installation without Intermediate Anchors and Guides**

The sketch shows a typical use of Badger Hinged Expansion Joints . . . not merely a hypothetical case but one of many instances where Hinged Joints serve as outlined above.

The problem was to run a steam line along two sides of a waterfront pier. However, since the pier structure was not strong enough to permit proper anchoring of the elbow in the pipe line, the standard type of joint could not be used. With these Badger Hinged Joints, it was possible to absorb the large amounts of thermal expansion in the pipe line without the need for an intermediate anchor.

Hinged Joints must always be used in groups of two or more. Three such joints give a maximum of flexibility while reducing to a minimum the thrust on the end anchors.

The Hinged Joint is but one of several special Badger Expansion Joints designed for unusual conditions. Why not outline your proposed pipe line installations to our engineering department? We can serve you whether special or conventional type expansion joints are needed. And back of our service is some sixty years of experience.

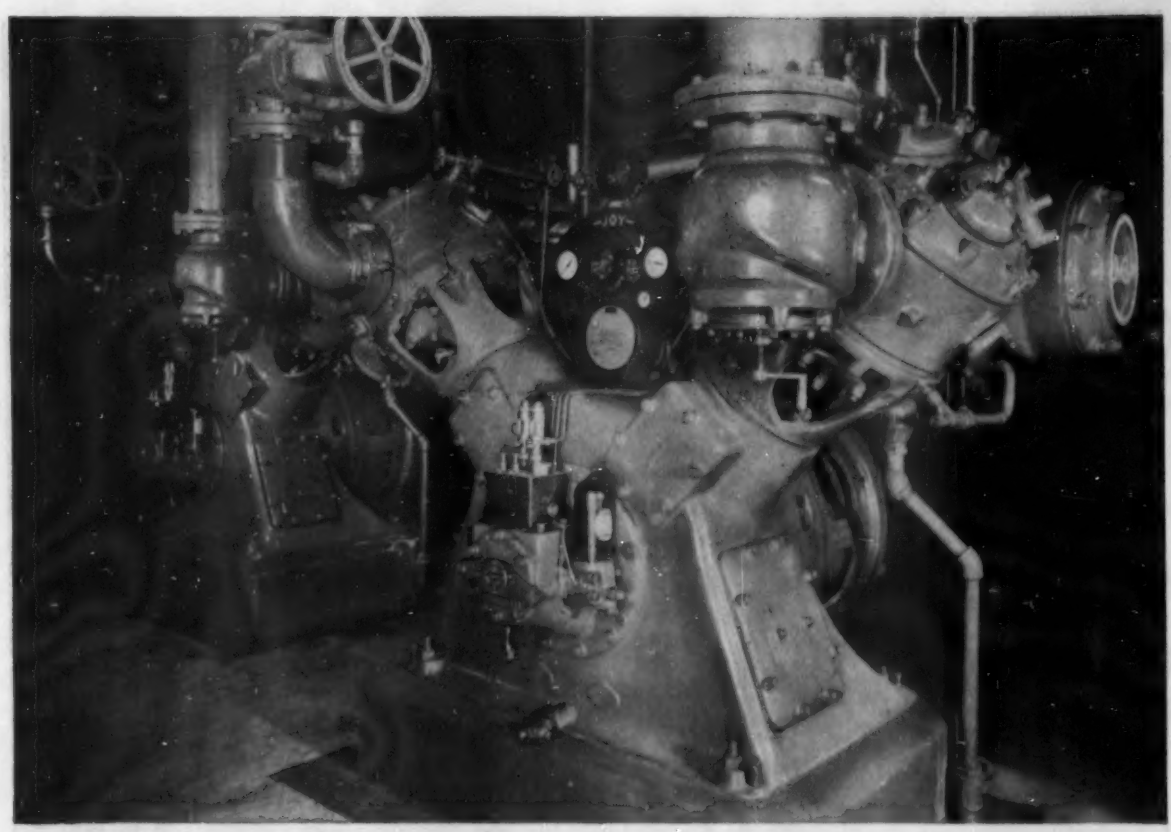
Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for longer traverses and higher pressure; Non-Equalizing, for shorter traverse and when pressures are low; Tandem Joints for combination axial and lateral movements; Clevis or Hinged Joints for angular rotation.

Corrugated Flexible Connectors; Flexible Pipe Line Seals for watertight connection between pipe and flood walls.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE 41, MASS.



The Case of the "GOOD AS NEW" COMPRESSORS

These two Joy WN-112 air compressors were used for several years in really heavy-duty operation under extremely tough conditions.

They were installed at different times . . . the newest about four years ago. Plant personnel report that, with nothing more than customary plant maintenance, they are still "good as new" and still furnishing, without shutdowns, the air to keep the plant in operation.

Durability and easy maintenance are built-in features of Joy WN-112 compressors. Cylinder and crosshead liners are field-replaceable, and made of alloy iron, honed to a mirror finish. Large area, low lift Joy "Dual Cushion" valves are set at the most efficient angle in both heads. Lubrication is by force-feed to all moving parts with automatic shut-off protection.

The Joy WN-112 is a heavy-duty, continuous service, two-stage, double-acting compressor of V-vertical design. It is normally powered by a flange-mounted motor but is adaptable to diesel, steam turbine, flexible coupling, V-belt or flat belt drive. It is a versatile machine and a compact space-saver in any plant.

For complete details on the Joy WN-112, write for Bulletin A-62 to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario*

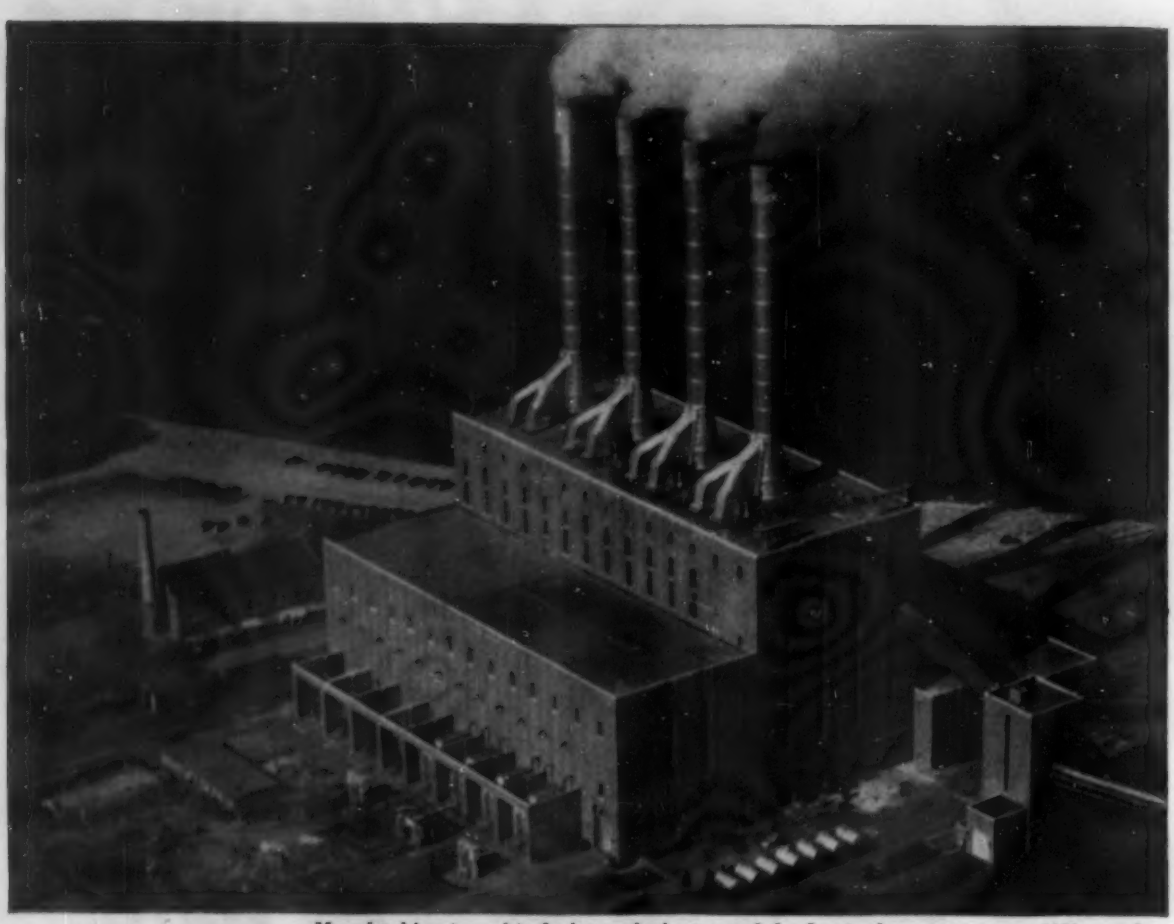
W&D 1 8807

Consult a Joy Engineer

for VANEAXIAL FANS • COMPRESSORS • VACUUM PUMPS AND BOOSTERS • OXYGEN GENERATORS

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



Monel tubing is used in final stage feedwater heaters at the 400,000 kw Oswego Station of Niagara Mohawk Power Corp. The plant—one of the first in the country to use 1250 pound steam at 900°F. — selected Monel tubing because high temperature strength was essential.

In high pressure, high-temperature service

Feedwater heaters with Monel tubes enter 15th year!

Not one Monel tube has needed replacement in high pressure feedwater heaters at the Oswego Station of Niagara Mohawk Power Corp.

The heaters operate at 2000 psi maximum and boost water temperature from 310°F. to 490°F. before it enters the boiler.

Naturally, the tube material must have high strength . . . good heat transfer properties . . . excellent resistance to corrosion.

Monel qualifies on every count! Keep Monel in mind when you design or re-tube a high pressure heater. And get full information now so you'll have it handy when the time comes. Write for Inco's Technical Bulletin T-5, "Engineering Properties of Monel." And information on new 85 foot tube lengths.

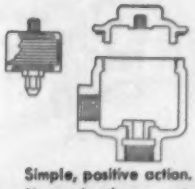
Each of the four high pressure feedwater heaters at the Oswego Station contains 132 U-shaped Monel tubes. The heaters, built by Griscom-Russell Company, Massillon, Ohio, were installed in 1940-41. Maintenance is seldom needed. Only one of the 528 Monel tubes has been plugged. None of the four heaters has even been opened during the last ten years.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

More POWER for you...with MONEL

INCO TRADE MARK NICKEL ALLOYS

Simplicity



Simple, positive action. Has only three parts —thermostatic bellows, body, cap. Won't leak!

Nicholson simplicity. Pays off big in steam distribution—in peak performance, easy maintenance. Simple in design, simple in operation, Nicholson Industrial Traps prove the most effective method for discharging condensate and air from steam lines.

- **Fast, intermittent valve action.**
- **Tight, positive shut-off.**
- **No dribbling. No waste of steam.**
- **Low operating cost. Low maintenance.**

Before you specify, check Nicholson. Write for *Catalog 953*.

NICHOLSON

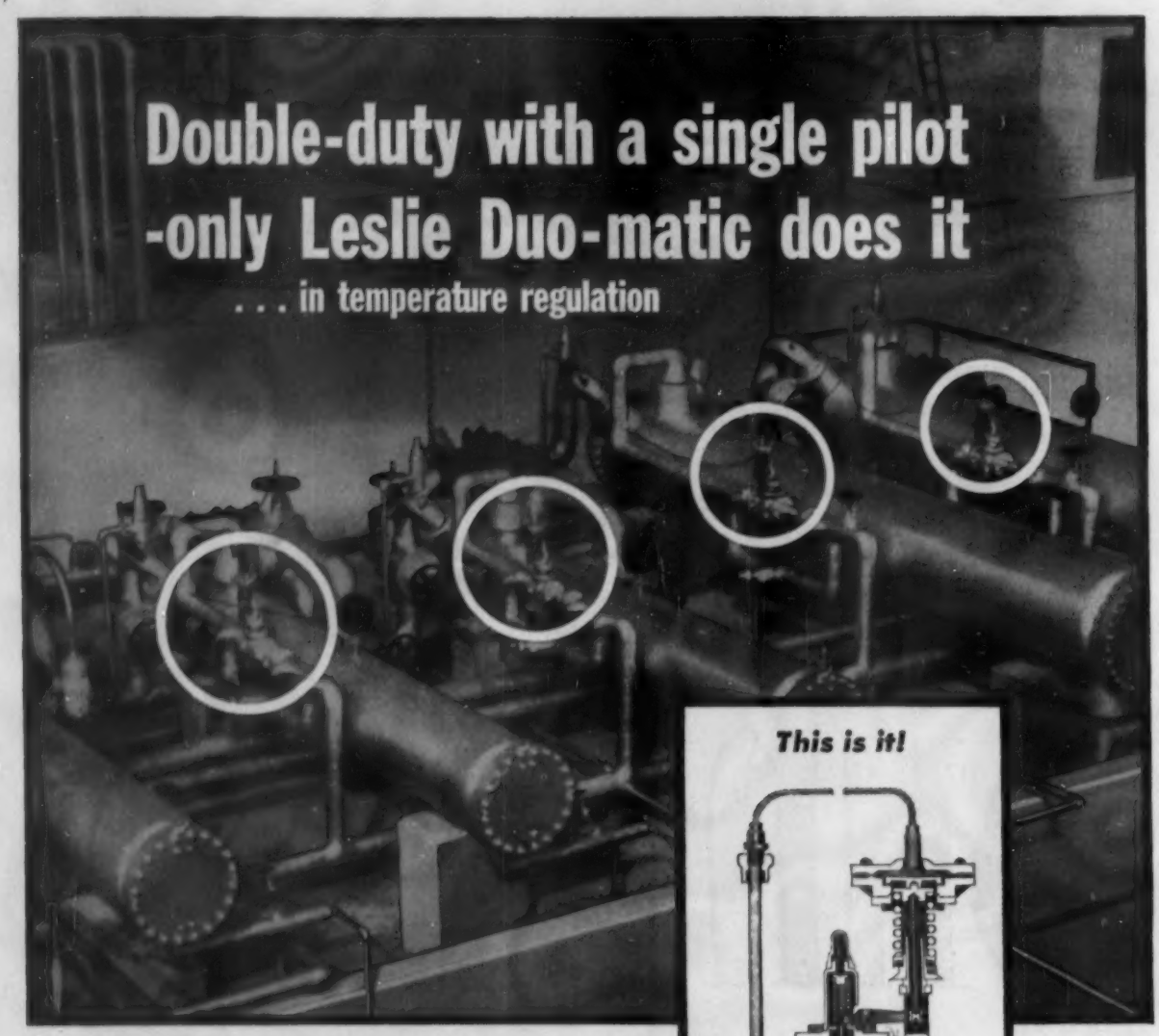
W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

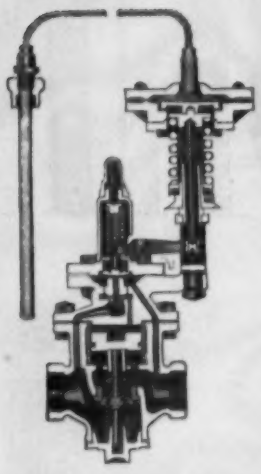
14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES

Double-duty with a single pilot -only Leslie Duo-matic does it

. . . in temperature regulation



This is it!



The Duo-matic Leslie temperature regulator for controlling steam flow is a single unit, with a *single* internal pilot valve—yet it controls automatically both temperature and pressure conditions. No hunting or cycling on low flows . . . eliminates temperature "droop" on heavy loads.

Simplified piping and better control of fuel oil heaters, instantaneous and storage type heaters, driers, process heaters, kettles, open tanks, ovens, degreasing machines, steam tables, sterilizers, etc., more than offset the initial cost of this superior regulator.

Investigate "dual-function" Duo-matic regulators — proven in service for over 19 years of applications.

Leslie Class LTCO Duo-matic temperature and pressure regulator.

WRITE FOR BULLETIN 5307

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY

CONTROLLED QUALITY MEANS QUALITY CONTROLS

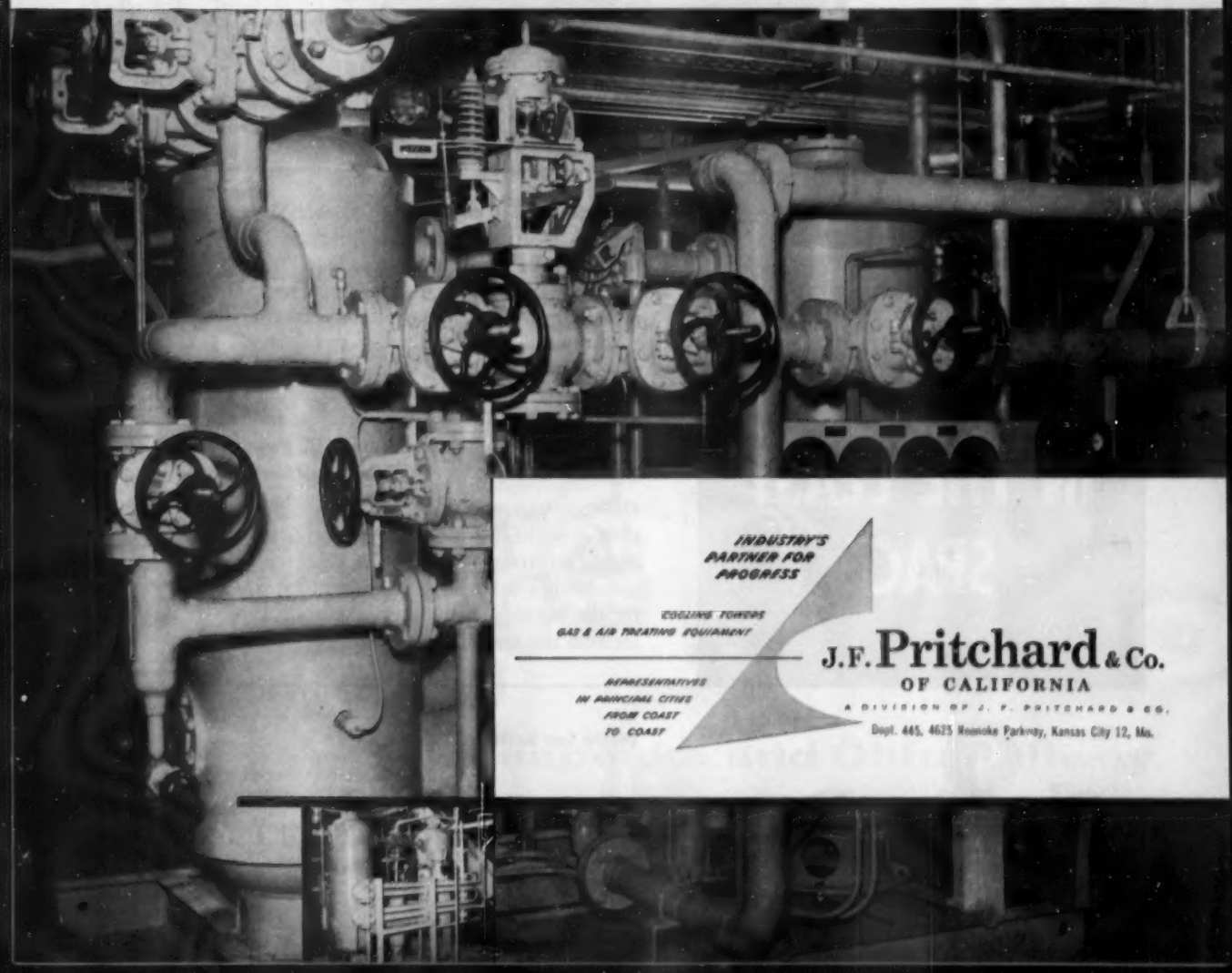
PACIFIC GAS & ELECTRIC

USES A HYDRYER TO DRY INSTRUMENT AIR!

Pacific Gas & Electric, San Francisco, Calif., uses a Pritchard HYDRYER® to dry instrument air at their Contra Costa Steam Plant, Antioch, Calif. The HYDRYER receives air from instrument air receivers and discharges into a single header supplying the plant instrument and control air system.

This packaged, Pritchard unit continuously delivers air with a dew point temperature not in excess of —20°F. capacity, 420 CFM at standard conditions; pressure 100 psig; temperature, 80°F.

The many repeat orders on HYDRYERS prove their performance record in the drying of instrument air and other gases in many industries. Find out more about these dependable, packaged dehydration units by writing for bulletin 16.0.081 today!



INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA

A DIVISION OF J. F. PRITCHARD & CO.

Dept. 445, 4625 Roanoke Parkway, Kansas City 12, Mo.

for the most in a Compressor

IN THE LEAST SPACE

The Class "Y" compressor offers everything a good compressor should have for heavy duty service: high overall efficiency, long life with minimum maintenance; smooth, quiet operation, accessibility and simplicity, compactness and ease of installation. With one-piece frame, it is shipped intact, including a flange-mounted motor—truly a "package" type unit. Built in sizes 75 to 250 H.P., it is available in single and multi-stage designs for pressures up to 5000 pounds, with belted, coupled or flange-mounted motor drive.

Simplate Valves, efficient and easy-to-clean shell-and-tube intercooler, multistep capacity regulation, roller main and precision type connecting rod bearings are some of the reasons for the big compressor performance of these medium size machines.

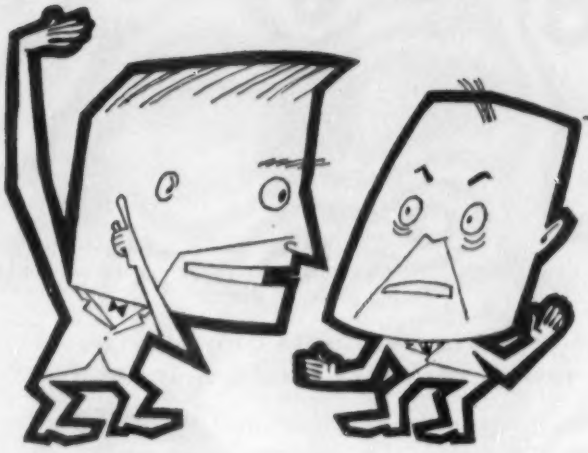
Write for Bulletin 766

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

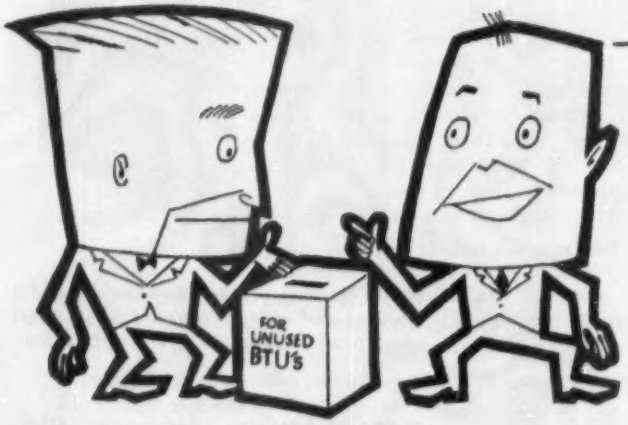
Fire the fireman! Here's another smoke summons.

Don't fire the fireman, he's doing his best. Let us look for a more adaptable coal.



What's wrong with the coal? It's high in BTU's.

Sure, it's a good coal—in the right furnace—but our set-up just can't supply enough air to burn all of the hydrocarbons before they cool off and blow up the chimney as free carbon.



There's no sense in buying BTU's we can't burn, is there?

You've got a point there—and one that so many people are never aware of. It isn't only what's in the coal that counts—it's what you can get out of it under your own set of conditions. That's why picking the right coal is a job for a competent combustion engineer. The superior quality coal produced at mines served by the Chesapeake and Ohio will meet our most exacting requirements. Before we sign another coal contract, let's get in touch with coal producers on the C&O or a C&O coal man to give us the facts and figures on which coal will cost us least in the long run.

P.S.

There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

"PACKAGED" FANS

Clarage V-belt Ready Units answer economically your smaller air handling requirements

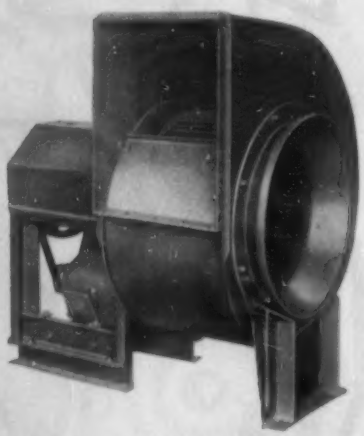
complete Ready to run, with fan, motor, and drive in one compact, easily installed assembly. 18 sizes, wheel diameters 9¾ to 32½", capacities to 12,000 cfm. Direct connected units also available.

adaptable Quickly adjustable in the field for various directions of air discharge. Slow speed, forward curved blade wheels or medium speed, backwardly inclined blade wheels available. Special units for handling corrosive gases and other special assignments can be provided.

rugged Typical Clarage heavy-duty construction throughout. All working parts readily accessible, yet entire drive (except on largest sizes) is within frame of unit — an important distinguishing feature!

quiet When properly selected and applied, Clarage Ready Units meet the most exacting requirements in respect to quietness of operation.

capable Within their performance range, these units are unsurpassed for maximum air delivery at low power cost. You can select them with confidence for ventilation, exhausting, and other low pressure applications.



View of a standard Ready Unit as built in the medium-size range. Note how operating parts are shielded.

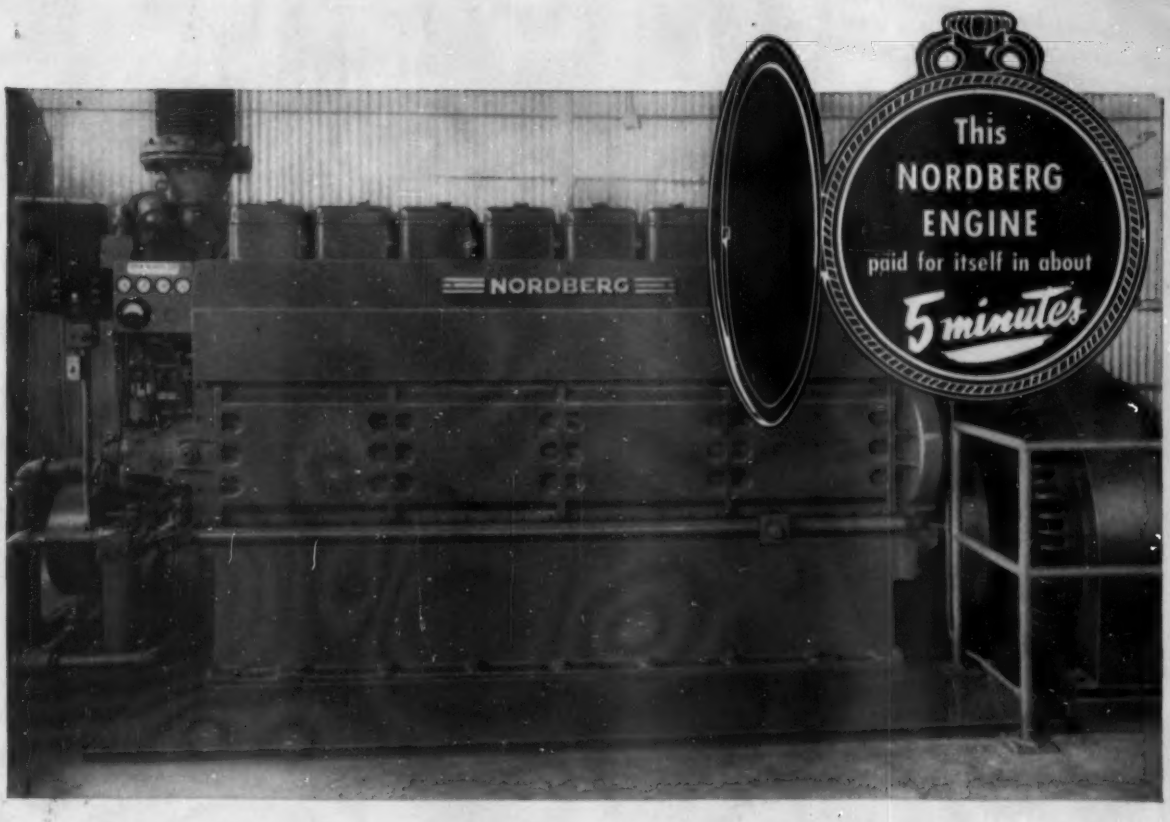
Ready Unit equipped with drive guard (at the end) and outdoor covers (on the sides) which provide complete weather protection.

For 28 pages of complete information on Clarage Ready Units, request Catalog 515.

CLARAGE FAN CO., Kalamazoo, Mich.

You can Rely on **CLARAGE** ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



Owens-Corning Fiberglas protects big plant investment with dependable Diesel stand-by power . . .

This Nordberg 720 hp, 500 kw Diesel generating unit supplies emergency power for the big Owens-Corning Fiberglas plant at Santa Clara, California.

To guard against shutdown caused by a failure of purchased power, the Nordberg Diesel is ready to take over the plant load at once, thereby protecting a huge plant investment in costly processing machinery. To make sure full power is instantly available, the engine is constantly maintained at operating temperature. Once each day the engine is started, paralleled with purchased power, and the plant load taken over for a short period . . . assuring its readiness, and training personnel for emergency operation.

Since this installation was made, several main power failures have occurred without warning. *In each case, the Nordberg stand-by unit was on the line and supplying emergency power within three minutes.* This service has more than saved the Diesel's original cost.

Here, then, is another outstanding example of the way Nordberg engines are serving industry.

NORDBERG ENGINES FOR EVERY POWER NEED

For regular or emergency service, you can't beat the advantages of Nordberg Diesels. They can be added to the line quickly, can be held ready for instant service without exorbitant standby expense, and are available for fully automatic operation. In the complete line of Nordberg two and four-cycle Diesel engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . from 10 to over 12,000 horsepower.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

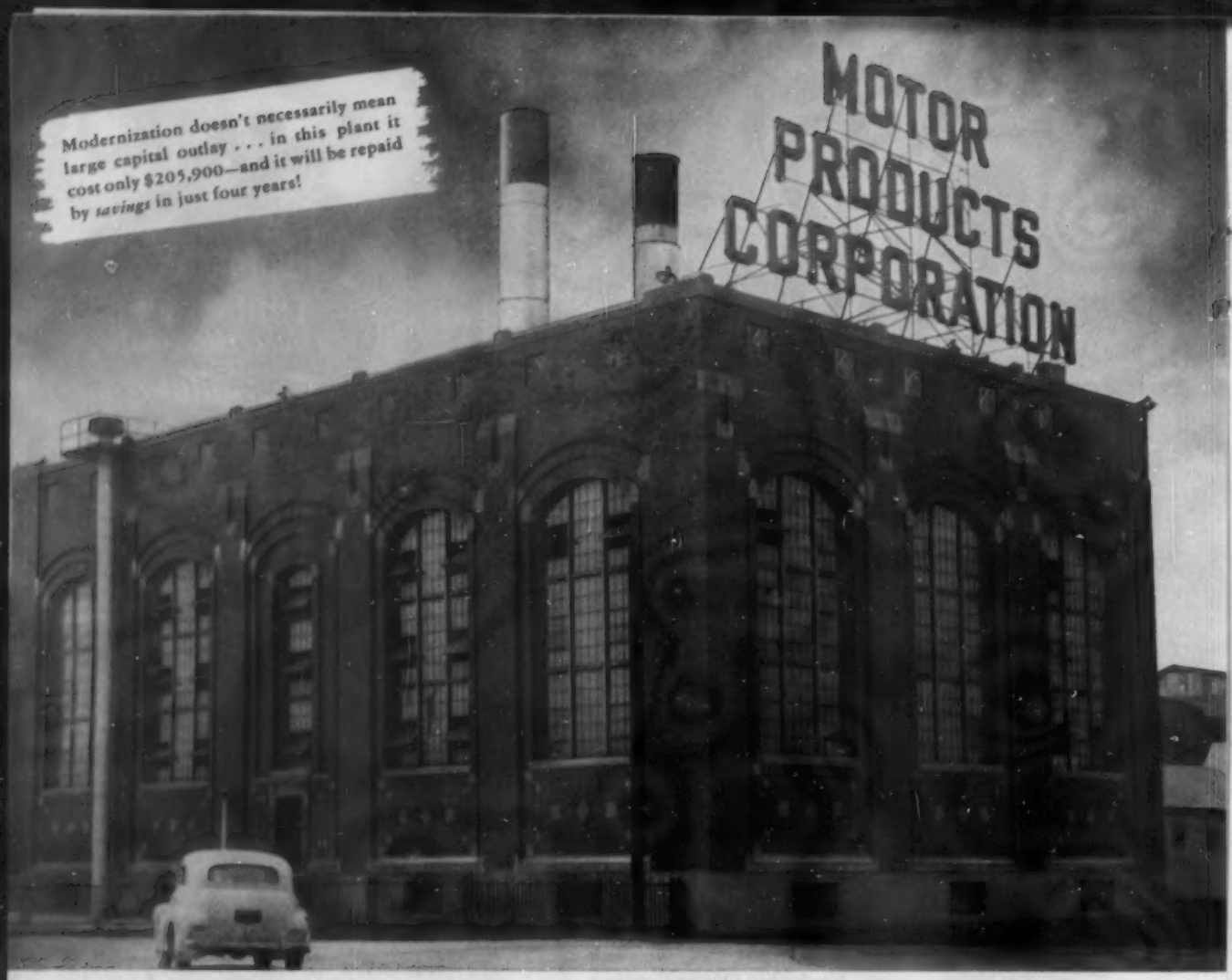
NORDBERG MFG. CO.
Milwaukee, Wisconsin
Builder of America's Largest Line of Heavy Duty Engines

MAIL THIS COUPON TODAY

Nordberg Mfg. Co., Milwaukee, Wisconsin
Send information on Nordberg engines in the _____hp range for _____service.

Name_____
Company_____
Address_____
City_____ Zone____ State_____

P655-R


Modernization doesn't necessarily mean large capital outlay . . . in this plant it cost only $205,900—and it will be repaid by *savings* in just four years!
MOTOR PRODUCTS CORPORATION

Burning coal the modern way saves Motor Products $54,000 a year

Faced with poor boiler control, air pollution difficulties, inefficient coal and ash handling and other costly defects in its outmoded power system, Motor Products Corp., Detroit, called in local consultants to make a study. The engineers recommended a modernization program, involving some new equipment along with the adaption of existing units to new systems.

This modernization is saving Motor Products time, labor, and money—better than $54,000 per year. Now the entire operation is clean and efficient. Production of economical steam is faster, simpler, more reliable and well within the bounds of smoke and dust regulations.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor? Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

Cut out

WASTED TIME AND MONEY

...just push a button

and leave the rest to

Limitorque

Automatic Valve Controls

Think of the time, labor and money that can be saved by opening and closing valves in remote, inaccessible or distant locations with LimiTorque Valve Controls.

LimiTorque not only operates valves at the speed required, but it "limits the torque" applied to the valve operating parts and thus prevents damage to stems, seats, discs or gates . . . and too, the handwheel "cannot rotate" when the valve is being motor-operated.

Send for Catalog L-54,

PHILADELPHIA GEAR WORKS
INCORPORATED

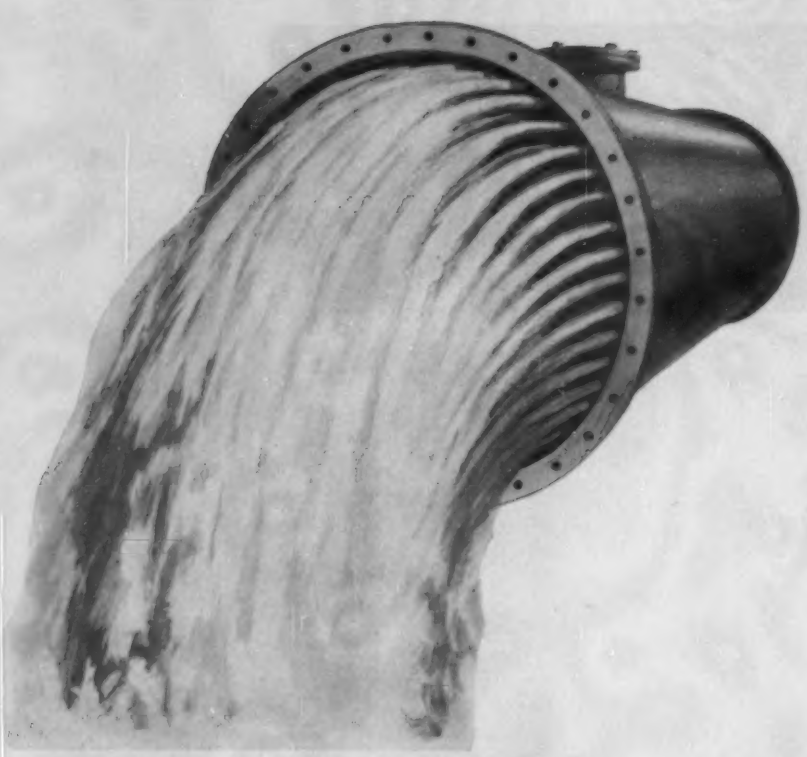
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
BALTIMORE • CLEVELAND

LimiTorque Corporation—Philadelphia

Industrial Gears & Speed Reducers • LimiTorque Valve Controls

Established 1892



How much does water affect your Condenser Tube costs?...

...that depends on how resistant your condenser tubes are to the corrosive bite of high water velocity... temperature changes... water composition... contamination... marine organisms.

Bridgeport's Technical Service and Corrosion Laboratory will be glad to help you select the condenser tube alloy best suited to your own operating conditions. Through years of research on the causes of corrosion, Bridgeport has developed a wide range of different alloys—one of which can give you longer service, better operating efficiency and substantially reduced maintenance costs.

For example: Bridgeport Duronze IV Alloy 53 (Arsenical Aluminum Bronze) and Aluminum Brass Alloy 54 offer excellent corrosion resistance to contaminated or corrosive sea waters and a wide variety of fresh waters. They resist impingement corrosion at higher velocities and give longer life under conditions too severe for ordinary condenser tube alloys

Are you receiving our Copper Alloy Bulletin regularly? We'd like to add your name to our mailing list, to get news of the latest developments in the Condenser Tube field and useful design and maintenance information.

To get more information on the Bridgeport alloy that's best suited for your particular application and for prompt service on your condenser tube requirements, call the nearest Bridgeport Sales Office.

Bridgeport BRASS CO.

BRIDGEPORT BRASS

Offices in Principal Cities • Conveniently Located Warehouses

Bridgeport Brass Company, Bridgeport 2, Connecticut
In Canada: Noranda Copper and Brass Limited, Montreal

The control gage board for Astoria's No. 10 boiler. At top: Hays Model WSF for mounting above eye level. Right center: Hays Model WCF8P for eye level. Four mounting styles are available to meet special requirements.

NEWEST TYPE **Hays Draft Gage**

Consolidated Edison's new Astoria Electric Generating plant at Queens, N.Y. is equipped specifically for the purpose of producing electricity at the lowest cost per kilowatt, reliably and continuously.

To meet these exacting requirements, Con Edison selected Hays W Gage . . . a completely new design in draft gages. Like other Hays low pressure instruments, the draft gage operating mechanism consists of a diaphragm enclosed in a cast metal housing. For pneumatically transmitted readings of Air, Steam, or Water Flow, Pressures, Temperatures, Levels, Oxygen, etc., the operating mechanism employs a bellows. The outstanding new features include: 3-way atmospheric vent cock, easy zero check, removable units for simple adjustment, and Lucite scales for easy reading.

Functionally designed and beautifully styled, the Hays W Gage provides exactly what instrument men have long demanded—an easily adjusted, easy-to-read, dependable draft gage!

Write today for full information on the Hays W Gage. Publication 52-1060-210.

Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Variflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

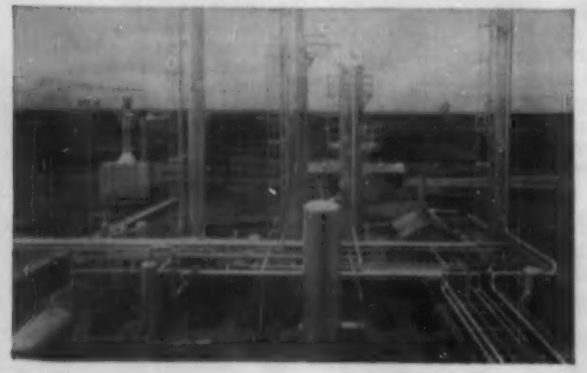
THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

it's easier to insulate pipe with Unibestos®

NO MATTER HOW COMPLEX THE PIPELINE, Unibestos insulation makes installation simpler. It's easily cut, mitered, or grooved for effective insulation of bends, expansion joints, ells, tees and other fittings.

Unibestos' unique construction provides greater protection against heat loss—even at the difficult joints—than other nonfibrous insulation. Amosite, the African long-fiber asbestos, gives Unibestos the extra strength to resist shock and vibration. And Unibestos has excellent chemical stability...withstands moisture, steam, acid or chemical fumes.



STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½" through 24", in standard thicknesses through 5". Unibestos Block Insulation is made in 6", 12", 18" or 36" widths and in thicknesses from 1" through 3" in ½" increments.

For complete information, write for descriptive Bulletin 109C

UNARCO®

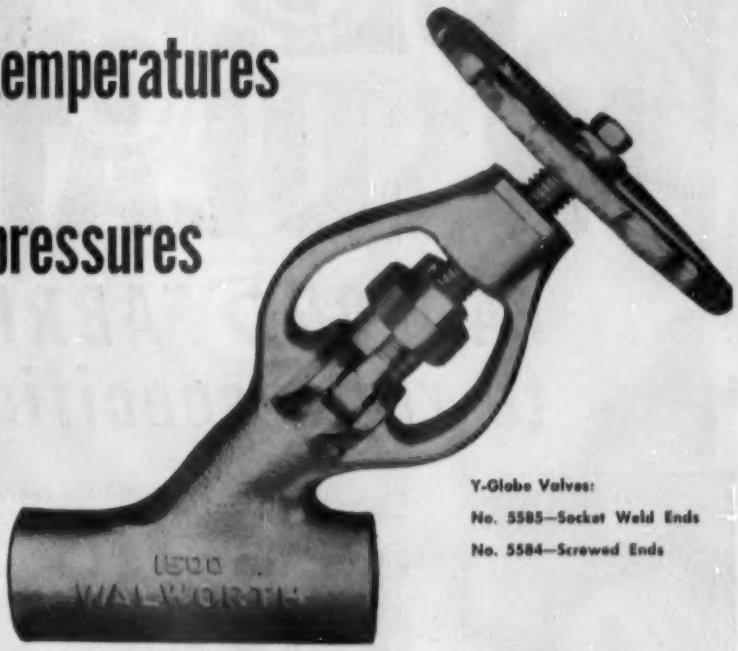
UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street • Bloomington, Illinois

Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle HIGH temperatures
HIGH pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—Socket Weld End
No. 5586—Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

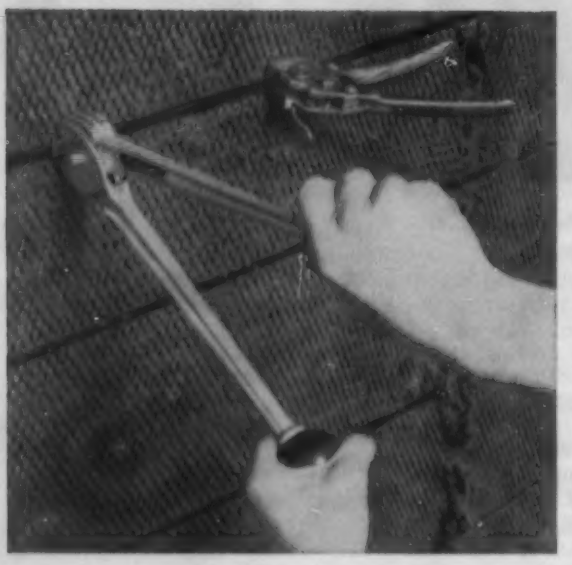
WALWORTH

valves • fittings • pipe wrenches

80 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

EAGLE-PICHER
BLANKET INSULATION
FACTORY FABRICATED to rigid specifications



FACTORY FABRICATION is your assurance Eagle-Picher Blankets are completely free of large "voids" usually found in field made blankets where insulation is simply packed in place. Because they're uniform these blankets can be tightly butted together to eliminate cracks and loose joints.

FACTORY FABRICATED to rigid specifications is your assurance that copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep the blankets firm but flexible. They can be quickly applied to flat or slightly curved surfaces on any large heated equipment—or cut to fit irregular areas.

FACTORY FABRICATED to rigid specifications means that *every* blanket is made up of many layers of Eagle-Picher mineral wool uniformly dispersed over the entire area of each blanket. The outstanding chemical and physical characteristics of Eagle-Picher mineral wool provide maximum thermal efficiency at temperatures as high as 1200 F.

WRITE FOR FREE SAMPLE TODAY!

Prove to yourself that Eagle-Picher Blankets are factory fabricated to meet your own exacting standards!

Since 1843

EAGLE EP PICHER

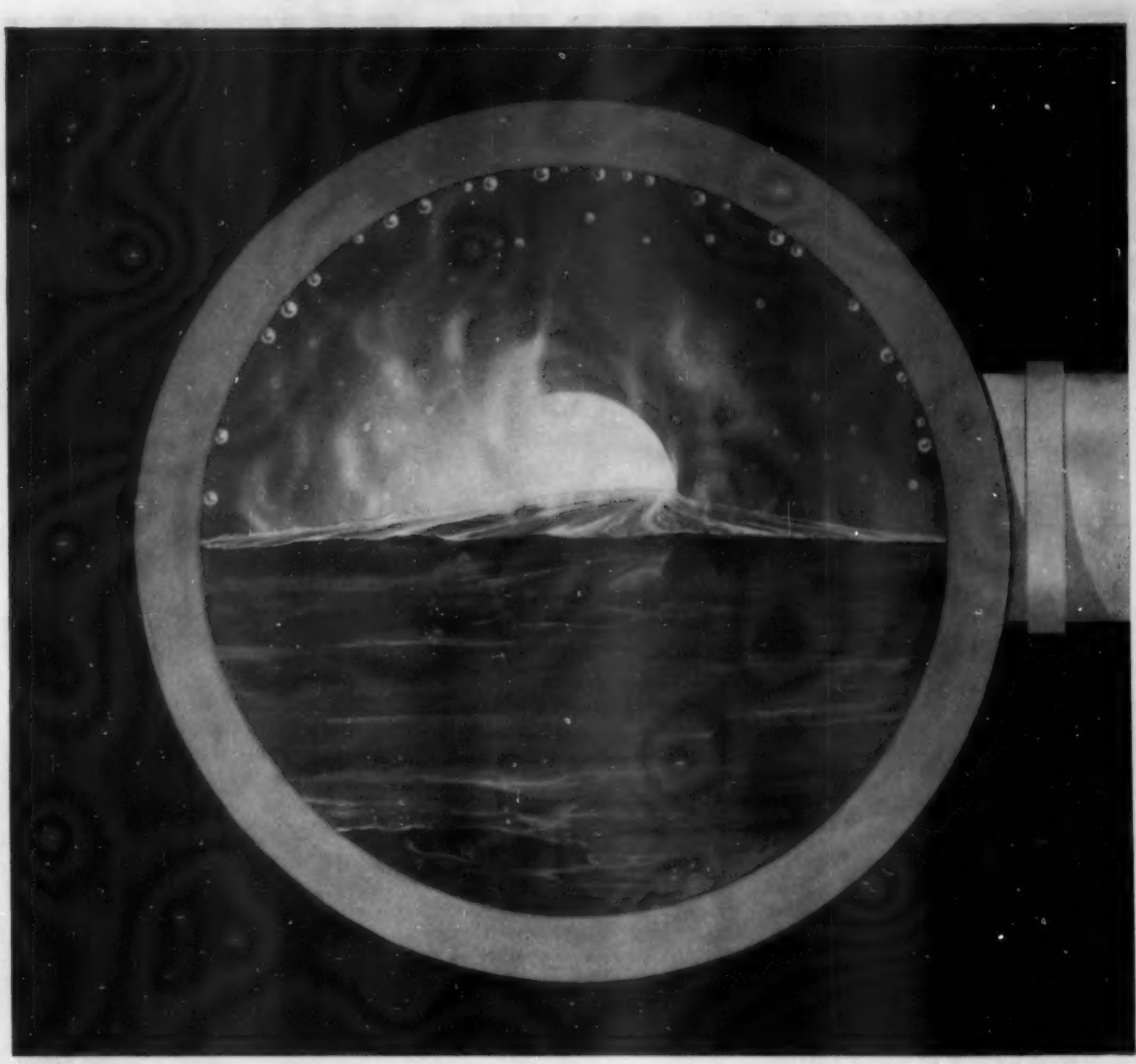
THE EAGLE-PICHER COMPANY

Producing a complete line of industrial insulations

Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

(Conforms to Commercial Standard CS 117 and Federal Specification HH-I-565)



WHAT'S A MONOMOLECULAR FILM?

It is a film one molecule thick. Filmeen* in steam or condensate lines produces a monomolecular film.

But, there's a lot more to it than thickness. The film's most important function is protection against corrosion. By forming a nonwettable coating on all metal surfaces with which treated steam or condensate come in contact, Filmeen provides a protective, corrosion-inhibiting barrier between water and metal. In heat exchange equipment, the condensed steam treated with Filmeen then forms as spherical drops of water which resist adherence to the film surface, much the same as a drop of water will form into a small ball on a waxed surface. This phenomenon results in increased rate of heat transfer—which in turn saves money in power plant operation.

When steam condenses on untreated return lines, it forms a continuous layer of water that restricts heat transfer. You don't want that... it raises the cost of heat.

Your Dearborn sales engineer will gladly explain how Filmeen can keep your heating costs in line.

**Filmeen is the trade-mark of a corrosion-inhibiting compound produced exclusively by Dearborn Chemical Co. U.S. Pat. No. RE 23614.*

Dearborn®

a leader in water conditioning and corrosion control

Dearborn Chemical Company
Dept. PO, Merchandise Mart Plaza, Chicago 54, Ill.

Please send me complete information about Filmeen.

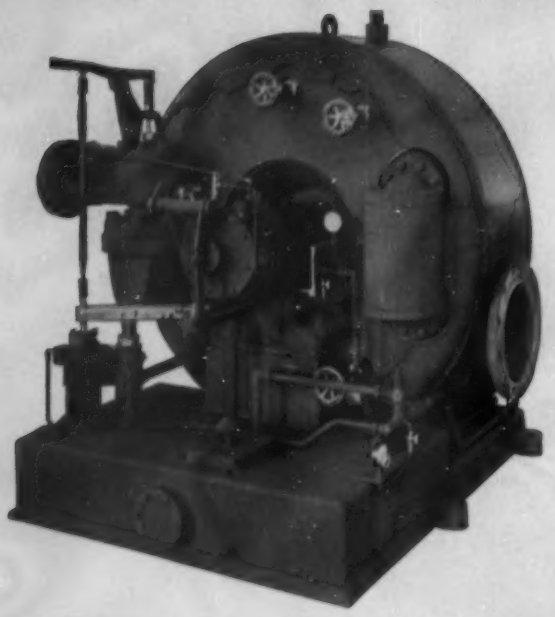
Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

TROUBLE-FREE TURBINE OPERATION STARTS HERE



Terry solid wheel turbines have become a symbol for dependable, trouble-free operation. The reason—simplicity and ruggedness of construction.

Take the rotor, for instance. It's a solid forging in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. Since the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

Simplicity outside too—as you can see from the photograph of the 1500 HP at 3500 RPM solid wheel turbine above. This turbine is equipped with an oil relay governor and forced feed lubrication to the bearings.

For more about these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

YT-1200

MECHANICAL CONSULTANT: KARSUNSKY, WELLER & GOOCH CO.

Holy Redeemer School Installs and Insulates 115-Foot Steam Line with Gilsulate® in 24 Man-Hours

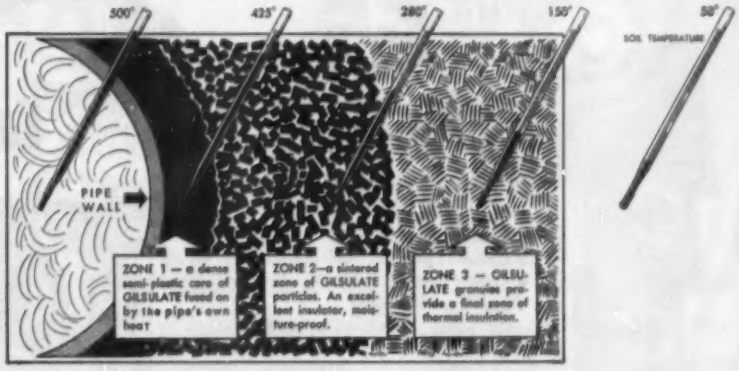
LOW-COST INSTALLATION HAS LIFETIME PROTECTION AGAINST HEAT LOSS AND CORROSION

Here's more proof that GILSULATE can save money for *you*—even on *small* as well as large jobs.

The Holy Redeemer School, Washington, D. C., recently installed 115 feet of 5-inch and 1¼-inch pipe for steam lines and return into their new 16-classroom building. Only 3 men were employed on the job. The installation was made in a trench 6 feet deep. The GILSULATE, after being wheeled to the top of the ditch, was skidded down and poured into forms around the pipes.

Total time for the *complete* job—including form construction, pouring 6½ tons of GILSULATE, and backfilling—was 24 man-hours. No other method for insulating and protecting hot underground pipes can match this performance—*Triple-Zone* GILSULATE *shows the lowest installed cost providing efficiency and permanence.*

Investigate the value of this easily installed, low-cost GILSULATE. Use the coupon below for complete information, or see your local GILSULATE distributor.


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — a dense semi-plastic core of GILSULATE fused on by the pipe's own heat
ZONE 2—a sintered zone of GILSULATE particles. An excellent insulator, moisture-proof.
ZONE 3 — GILSULATE granules provide a final zone of thermal insulation.

Facts about Gilsulate

1. *Easy to use*—just pour, tamp and backfill... pipe heat does the rest.
2. *Forms 3 zones* of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. *Needs no housing or mechanical sheaths:* no mixing, special handling or equipment.
4. *Only needs normal pipe spacing:* for multiple pipe or cramped conditions.
5. *Three types available:*
   Type A for 220°-310° F. temp. range
   Type B for 300°-385° F. temp. range
   Type C for 385°-520° F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
134-F West Broadway, Salt Lake City 1, Utah — or — 1145 East Jersey St., Elizabeth, N. J.

Send me more information on GILSULATE Insulation

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

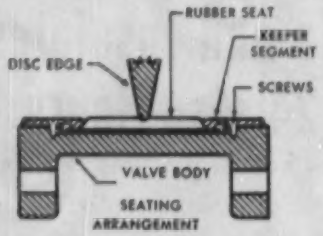
HPA

Now!..Bottle-Tight Butterfly Valves in ratings to 125 P.S.I.

Corrosion cannot hinder operation . . . Even if not operated for long periods, a Henry Pratt Butterfly Valve will open or close easily. These valves are not subject to "corrosion seizing" because all seating surfaces are non-corrosive. The disc edge is either stainless steel or chrome-plated, and it closes into a thick rubber seat. These features, coupled with Oilite bearings and stainless steel shafting, make it impossible for valves to "corrode tight" either open or shut.

Full 90° closure into Rubber Seat . . . The disc diameter is slightly larger than the inside diameter of the rubber seat and thus when rotated to the full closed position the disc actually displaces the rubber. This seat has been designed so that the ratio of seat thickness to disc indentation insures bottle-tight shut-off while minimizing permanent set and excessive abrasion.

The resilient seat material is reinforced by heavy canvas insertions to increase seat strength. The seats are secured in the valve body by removable keeper segments.



Before shipment all valves undergo rigorous leakage tests to insure compliance with leakage guarantees.

Sound design features in both low and high pressure ratings . . . Valves are manufactured in sizes from 10 to 168 inches in diameter. Valve construction can be either cast iron or fabricated steel. Operator types available include hand wheel, chain wheel, limitorque electric motor, hydraulic cylinder, air cylinder, etc. All Henry Pratt Rubber Seat Butterfly Valves are suitable for an operating temperature range of −20° to +190°F.

54" Limitorque electric motor operated, low pressure standard rubber seat butterfly valve.

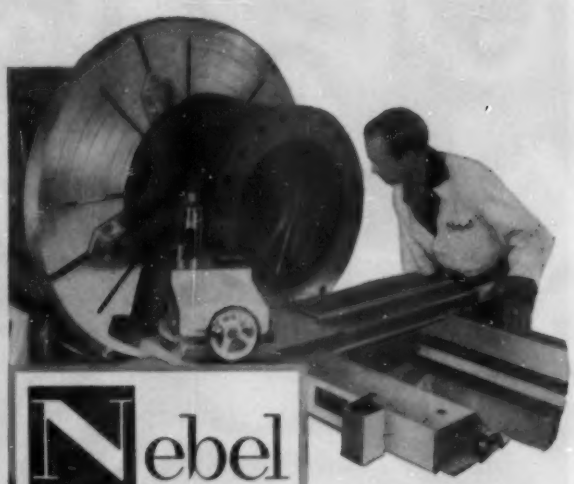
24" Handwheel operated, high pressure standard rubber seat butterfly valve.

HENRY PRATT

Write for full details . . .
"Understanding Butterfly Valves", Bulletin 2-K
Low Pressure Valves, Bulletin 1-K
High Pressure Valves, Bulletin 4-K

RUBBER SEAT
Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities



Nebel LATHES CINCINNATI

basic maintenance tool

Nebel extension bed gap lathes will turn all your maintenance jobs easily, quickly and inexpensively. The wide, deep gap accommodates outsize, odd-shaped parts . . . and with the gap closed, you can do all your engine lathe work as well. Why buy two lathes when one Nebel will do? See Nebel gap and engine lathes at the Machine Tool Show, Chicago, Sept. 6-17 . . . or write for free bulletins, sizes 16"-50". The Nebel Machine Tool Co., Cinti 25, Ohio.

Solve your toughest
HI-TEMP THREAD Problems
with **C-5**

SEND FOR TEST SAMPLE **FREE**

No More SEIZING or GALLING of STUDS, Even at 1800°F

- ✓ Prevents stud breakage
- ✓ Eliminates pitting of Stainless Steel
- ✓ Reduces Torque
- ✓ Speeds up Disassembly

NOW, being used for boiler, manhole, handhole and face plate studs, turbine header studs, flange bolts on high temperature valves, steam lines, pumps, etc.

844PRR

C-5 FEL-PRO "HI-TEMP" ANTI-SEIZE THREAD COMPOUND

Fel-Pro's exclusive C-5 colloidal-copper formula "copper-plates" metal . . . gives maximum cushioning and protection up to 1800°F without breakdown. Prevents galvanic action —eliminates pitting even where dissimilar metals are joined. Protects all threaded surfaces of bolts, plugs and studs, insuring their repeated re-use.

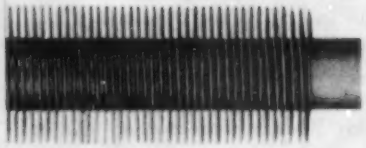
SEND FOR FREE SAMPLE TODAY on your company letterhead.

FELT PRODUCTS MFG. CO.
1539 Carroll Ave., Chicago 7, Ill.

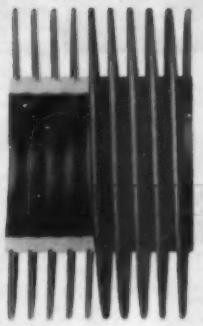
G-R and Nuclear Power

From the start of the use of nuclear power The Griscom-Russell Company has been adopting and designing heat exchange equipment for this modern industry. The experience of G-R in specially designed heat transfer equipment throughout the years is available to meet your requirements.

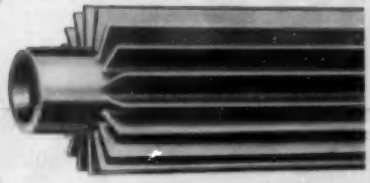
Extended Surfaces for Heat Transfer Efficiency



3K6—Helically finned tubing for use in lightweight airborne equipment where the fluid outside the tubes has a cross-flow for metal temperatures up to 1600° F.



15K24—Helically finned tubing used in stationary installations where the fluid outside the tubes has a cross-flow for metal temperatures up to 1600° F.



G-Fin Pipe—an efficient extended surface for longitudinal flow for metal temperatures up to 1600° F.

Double Wall Tube...

to prevent interleakage due to tube or tube joint failures. Can be monitored with inert gas.

SPECIAL DESIGNS for New Problems is Our Forte

The Griscom-Russell Company has made heat exchanger designs for use with —

High Pressure Water Reactors • Sodium Cooled Reactors • Helium Cooled Reactors • Boiling Water Reactors • Homogenous Reactors (Aqueous and high temperature)

THE GRISCOM-RUSSELL CO.
MASSILLON, OHIO
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

G-R HEAT TRANSFER APPARATUS

Heat Exchangers

SAVE WITH SEALS

American industry loses billions yearly in leakage and costly equipment downtime resulting from faulty seals—gaskets, packing, piston rings, mechanical seals.

You can stop such losses in your plant by knowing how to select and apply sealing devices.

Now, for the first time, the information you need to do this cost-cutting job is available in a single package.

HERE'S HOW:

Separately, these reprints are priced at 60¢ each. For a short time, we will send you all three, in an attractive data file FOR ONLY $1.50. And if you order now, will include a card enabling you to reserve Part 4 at a special prepublication price.

START SAVING TODAY

Order these reprints now—vital, practical, easy-to-use data giving all you need to know about gaskets, piston rings, packing, mechanical seals.

Gaskets. 20 pages of intensely practical material on gaskets. Covers various gasket materials including asbestos, natural and synthetic rubber. Neoprene, Kel-F, phenolic resins and metals. How to lay out, cut and install gaskets.

Mechanical Packing. Don't let any man in your plant tighten a gland nut until he grasps ideas in this report. Here are packing basics and know-how, never before told in print. Sketches, curves and detailed illustrations tell you how a packing seals, how it's applied, how to prevent costly rod and shaft wear.

Piston Rings. 24-page section gives the dope on the cylinder sealing problem in general, describes ring types, tells you where to use them. Passes along tips on installing, operating, renewing rings, plus making them in emergencies.

Mechanical Seals. Coming in 1956. 24 pages of illustrations and text showing and explaining in simple language what mechanical seals are, what jobs they do and how to apply them to your equipment. These seals do not wear your shafts, are now running up to 100,000 rpm, at 500 F without a drop of leakage, in smaller sizes.

ORDER TODAY— OFFER IS LIMITED

POWER
330 W. 42nd St.
New York 36, N.Y.

Please send ..... sets of Basic Data on Seals.
I enclose $.....
Include my special bonus card with each set

NAME _____

STREET _____

CITY _____ ZONE NO. _____ STATE _____

Please reply before October 15, 1955. This coupon void after that date.

PROFESSIONAL SERVICES

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
1706 Broadway — Kansas City 12, Missouri

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088

GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
Engineering and Design • Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing
607 Washington St., Reading, Pa.
New York • Philadelphia • Washington

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. — Philadelphia 21, Pa.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

LUTZ AND MAY COMPANY
Consulting Engineers
STEAM, GAS & DIESEL POWER STATION
PUMPING PLANTS—ELECTRIC SYSTEMS
REPORTS—DESIGN—APPRAISALS
1080 Baltimore — Kansas City 6, Mo.

MORGAN AND ASSOCIATES
Power and Utility Cost Consultants
Specialists in Cost Reduction Studies, Surveys, Analysis and Reports.
Electricity • Steam • Coal • Oil • Gas
Water • Air
1929 S. Taylor Rd. — Cleveland 18, Ohio

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. — Chicago 4

SANDERSON & PORTER ENGINEERS
Design
CONSTRUCTION SUPERVISION
New York — New York

SARGENT & LUNDY
Engineers
140 South Dearborn St. — Chicago, Illinois

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical — Electrical — Civil
Surveys Reports Design
101 Park Avenue — New York 17, N. Y.

J. E. SIRRINE COMPANY
Engineers
Power Plants — Consultations
Design — Reports
Water — Steam Utilization — Plants
Greenville — South Carolina

STANLEY ENGINEERING COMPANY
Consulting Engineers
337 S. LaSalle Street — Hershey Building
Chicago 4, Illinois — Muscatine, Iowa

A. L. SWANSON AND COMPANY
Consulting Engineers
Power Plants
Sawmills—Industrial Plant Layout
Heating—Ventilating—Plumbing
Reports, Designs, Drawings, Specifications
2210 West 12th Avenue — Vancouver 9, B. C.

WATER SERVICE LABORATORIES, INC.
Water Treatment for corrosion control in buildings, boilers and air conditioning systems—Chemical Laboratory Services—Consultation.
New York—Philadelphia—Washington, D. C.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

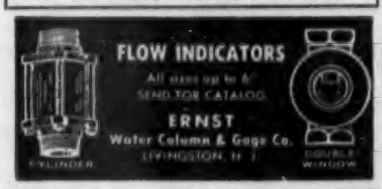
WHERE TO BUY

Featuring additional products, specialties & services for power plants

A.C. Anywhere — 350 Watts to 400 K.W.
with KATO GENERATORS
Larger sizes available in speeds of 720, 900, 1200, 1800 R.P.M. at 60 cycles. Can be furnished adaptable to engine of your choice. Many sizes available with direct or belted exciter. Odd frequencies from 25 to 400 cycles are our specialty. Can be arranged for standard S.A.E. engine bell housing adaptation.

Manufacturers of electrical machinery since 1926!
WRITE TODAY FOR FULL DETAILS AND FREE LITERATURE.
KATO Engineering Company
1479 FIRST AVENUE, MANKATO, MINNESOTA

STEEL PIPE & TUBING
• CHROME MOLY • CARBON MOLY
• MONEL • CARBON STEEL • STAINLESS
• HASTELLOY
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030



TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers—The readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

Classified Advertising
POWER

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.65 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)

POSITION WANTED undisplayed rate is one-half of above rate, payable in advance.

BOX NUMBERS count one additional line.

INFORMATION

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. PR

DISPLAYED RATE

The advertising rate is $17.90 per inch for Equipment & Business opportunities advertising appearing on other than a contract basis. Contract rates quoted on request.

EMPLOYMENT OPPORTUNITIES. $25 per inch, subject to agency commission.

NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the September issue closing August 9th.

OPENING AVAILABLE AT LONG ESTABLISHED MEDITERRANEAN COPPER PROPERTY

ASSISTANT CHIEF ENGINEER

Age limit 45 preferably about 35. Must be graduate mechanical, chemical or civil engineer with natural mechanical ability, excellent practical and supervisory and some construction experience, for charge under Chief Engineer of all shops, foundry, mobile equipment including loading, marine, railway and construction; maintenance and repair of all types of equipment; 7250 KVA diesel generating plant.

Forward with initial reply complete educational and experience records, list of references, age, marital status, number and age of children, photo (optional). Company offers three year contract, furnished house, transportation self and family, liberal vacations. Excellent climate, living conditions, medical and hospital facilities. School to 14 years. Non-contributory pension plan. Salary open.

P-6780, POWER
1111 Wilshire Boulevard
Los Angeles, California

ELECTRICAL ENGINEER
SUPERVISOR-TRAINEE

to assist supervisor in maintenance and construction work in a sizable midwestern educational institution. Applicant must have a minimum of 2-3 years college and preferably some practical experience. Employee benefits include a pension plan, paid vacation, sick leave, etc.

P-7016, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

Wanted: District Sales Manager, Eastern Seaboard, by an old established midwest manufacturer of regulating valves. We sell in the low pressure industrial field mostly through plumbing and heating jobbers but we require good practical knowledge of application engineering as well as sales acquaintance. Salary and bonus. Address L. G. L. Thomas, P. O. Box 6010, North Philadelphia Station, Philadelphia 32, Pa.

POSITION WANTED

Power Plant Superintendent, age 33, married, technical education, 10 years experience in the operation and maintenance of steam-electric power plants. Understands personnel problems. PW-6009, Power.

SELLING OPPORTUNITY WANTED

Manufacturers Representative available to sell line of large steel fittings and valves, diaphragm valves, safety and relief valves, globe and angle valves to wholesalers and major consumers for northern N. J. terr. Norse Engineering Co., 20 Race St. North Plainfield, N. J.

WANTED

ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

ENGINEER

Large multi-plant chemical manufacturer requires a young chemical or mechanical engineer with several years' plant production or power plant experience.

This is your opportunity to affiliate with a company which is the leader in its field and presently expanding. The job provides an excellent opportunity to learn the Company's complete operation with good possibilities of achieving higher responsibilities within a reasonably short time.

Please submit a complete resume of education and experience with past record of earnings and initial salary desired. Also enclose a recent snapshot if available.

P-6883, POWER
520 N. Michigan Ave., Chicago 11, Ill.

FOR SALE

6—100 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
6—75 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
9—37½ KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.
19—15 KVA 60 cy. 1 ph. Dry Type 240/480-120/240
15—25 KVA 60 cy 1 ph. Dry Type 240/480—120/240
8—37½ KVA 60 cy. 1 ph. Dry Type 240/480—120/240.
3—50 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.
3—10 KVA 60 cy 3 ph. Dry Type 480—208Y/120.
2—37½ KVA 60 cy 3 ph Dry Type 480—208Y/120.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St., Phila. 20, Pa.
Phone: Michigan 4-6963

MOTOR

200 H.P. New (never used) 3600 RPM, 2200/3/60 sq. cage Protected type B.B. Motor. G.E., type K, frame 6326-S.

Bargain For Quick Sale

SOUL CLINIC INC.
CALGARY, CANADA

FOR SALE

WOODEN TANK—25,000 GAL.

Excellent Condition

16 ft. diam.—16 ft. high Price $600.00

IRON OXIDE CORP.
125 Front St., Elizabeth, N. J.

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers • or Complete Power plants.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

2—500 KW.

M-G SETS, SYNCHRONOUS

700 H.P. Gen. Elec. syn motor type ATI-10-560-M from C Serial #4, 098,611 3 PH. 60 cycle 13,200 volt 720 R.P.M. 24 amps 1.00 P.F. direct connected to 500 K.W., Gen. Elec. direct current generator type M.C.F. 8 serial—#1,447,484 125 volts 720 R.P.M. or 4000 amps. Note: This is a three pedestal bearing set, mounted on Gen. Elec. common base. Other machine same as above serial #A.C.—end #1,177,910 D.C.—end 646,136.

These sets are in very good condition, having just been removed from service; Available immediately at $4000.00 ea.

JARRAP CORPORATION
2416 Richmond, Phila. 25, Pa.
GA. 6-8227

BOILERS

3—Kewanee Firebox Boilers, 304 HP, 125 PSI WP, Series 500, Model 500. ASME & Natl. Board stamped. New 1942.
3—153 HP Union Iron Works, 160 PSI, Bent Tube ASME, oil burners.
1—250 HP, B. & W. Stirling, 150 PSI, ASME, comb. gas & oil burners.
2—4' x 135' Steel Stacks.

HEAT & POWER CO., INC.
60 East 42 Street New York 17, N. Y.
MUrray Hill 7-5280

BOILER FOR SALE

120 H.P.—CR 352 INTERNATIONAL
Water-tube with Petro oil-fired burner
Automatic Controls • Excellent Condition
Now in operation

MARCO PRODUCTS, INC.
Yorkes Road, Bridgeport, Penna.

DIESEL GENERATOR SET

CHICAGO PNEUMATIC MODEL 68CP, 225 HP, 720 R.P.M. Diesel Complete, in excellent condition.

Direct connected EM 200 KW, 440 volt, 3 phase, 60 cycle Generator, like new. EM switchboard panel complete, with necessary switches, instruments, including synchroscope, like new.

Price $5250 FOB Our Plant

Detailed Information Sent Upon Request.

CHIPPEWA FALLS WOOLEN MILL CO.
Chippewa Falls, Wisconsin

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT

SELECTED STOCK ITEMS

RE-NU-BUILT—GUARANTEED—RE-NU-BILT

COMBINATION MILL DRIVES — 15/2500 HP

D.C. MOTORS WITH M.G. SETS & CONTROLS

	MAKE	TYPE	VOLTS	R.P.M.
2500 HP	Whse.		600	600
2000 KW	G.E.	Syn.	2300/4000	450
2250 HP	G.E.	MCF-12	600	400/500
2000 KW	G.E.	Syn.	2300/4000	450
900/				
1400 HP	G.E.	MCF14	330/600	40/83/100
1500 KW	G.E.	Syn.	6000/13200	720
1250 HP	Whse.	Rev.	600	300/600
1000 KW	G.E.	Syn.	2300/4000	720
1250 HP	G.E.	MCF	600	750/900
1000 KW	G.E.	Syn.	2300/4000	720
1000 HP	G.E.	MCF-8	600	350/700
1000 KW	G.E.	Syn.	2300/4160	720
500 HP	Whse.	Mill	600	300/900
500 KW	Whse.	Syn.	2300	1200
350 HP	Whse.	Mill	250	350/700
300 KW	Whse.	Syn.	220/440	1200
200 HP	G.E.	CD-1650Z	250	300/1500
200 KW	Cr. Wh.	Syn.	6600/13200	720
200 HP	Whse.	CR-511.3	250	400/800
200 KW	Rl. Mach.	Syn.	220/440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1500	ABB		2858	720
1	1000	A.C.	Mill	2300	514
1	800	G.E.	MT	2300	720
1	750	Al. Ch.	D.P.	2300	360
1	500	G.E.	MT-412	2200	600
1	500	G.E.	M-574T	6600	900
1	500	Whse.	CW	550	550
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435

SQUIRREL CAGE

2	650	G.E.	FT-509BY	440	2070
1	500	G.E.	K-03458	2300	1185
2	450	Whse.	CR-1426	2300/4160	884
1	400	G.E.	1E-15B	2300	1165
1	300	Whse.	CR	440	1170
1	200	G.E.	1K-17	440	880
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CR-8568	440	880
1	150	Whse.	CR	440	580

SYNCHRONOUS

1	4250	C.W.	3501-8L	13800/6900	514
2	2100	G.E.	ATI	2300	300
2	1750	G.E.	ATI	2300	3600
2	2000	Whse.		2300	720
1	725	G.E.	ATI	2200/13800	600
1	500	Ydeal	SM	2300/4160	1800
2	500	G.E.	TS-7587	2200	1200
1	450	Whse.		2200	450
1	400	G.E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2340/4600
1	2000	G.E.	450	600	2340/4600
1	2000	G.E.	600 25cy	600	11000
2	2000	G.E.	514	600	6000/13200
1	1750/2100	G.E.	514	250/300	4800/2400
1	1800	G.E.	720	600	6600/13200
1	1000	C.W.	514	30/115	4600/12000
1	1000	G.E.	720	600	2300/4600
1	1000	G.E.	900	300	6600
1	750	C.W.	514	30/115	2300
1	750	G.E.	900	125/250	2200
1	600	G.E.	720	250	440/2300
1	500	Whse.	1200	115/230	2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Wagner	HPW-30	3	26400x2400
2	4200	G.E.-Fur.	FOWT	3	13800x200/87
3	2000	G.E.	HVDDJ	1	66000/13800

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	5000	G.E.	60/50/60	6600/11000/6600
2	3000	G.E.	60/25	2300/2300/4000
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/55.5	4400/2300
1	500	Al. Ch.	3560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 5/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto. extraction 190 lbs.—660° F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200 lbs. I.S.P. 5/20 lbs. G. Ext. Surface Condenser—5/60/2300.
1	1000	G.E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 450/3/60.
1	750	G.E.	Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

CHECK WITH WAGNER FIRST

"Certified Rebuilt" Motors and Generators

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	250	1000
200	Allis Ch. b.b.	EW	250	850
150	Whse.	SK-201	230	300/900
150	Whse.	SK-184	230	850
150	Gen. Elec,.	BC-16	230	1700
150	Whse.	SK-173	230	850
100	Reliance	681T	550	1000/1600
100	Reliance	681-T	230	575/1150
75	Cr. Wh. TEFC	5611	230	850
75	F. Morse b.b.	DH-140	115	1600
50	Gen. Elec.	RF-14	230	500/1200
50	G.E. dynam. (4)	TLC28	230	1000/2000
50	Whse. (2)	SK-143	230	850
40	Whse. (2)	SK-132	230	850
35	Whse.	SK-162	230	300/900
40	Imperial b.b.	[illegible]	230	400/1000
30	Star b.b. (2)	MH	230	1750
25	L. A. TEFC	HVA	230	850

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	Allis Ch.	2200/440 AC	125/250 DC
250	Allis Ch.	2200/440 AC	250 DC
200	Whse.*	220/440 AC	85 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125 DC
150	Whse.	2300/440 AC	275 DC
125	Gen. Elec.*	2300/6000 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	F. Morse b.b.	220/440 AC	125/250 DC
75	Cent. b.b.	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
40	Whse. (2)	220/440 AC	250 DC
30	Gen. Elec. (2)	220/440 AC	125 DC
30	F. Morse b.b.	220/440 AC	24 DC
30	Allis Ch. (2)	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
20	Rel. b.b. (2)	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis Ch. b.b.	EW	250	1200
175	Allis Ch. b.b.	EW	250	900
150	Gen. Elec.	BC	250	1200
125	Whse.	SK-184	250	1150
105	Century b.b.	1000 amp.	70	1200
100	Whse.	SK-173	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	681T	600	1200
75	F.M. b.b.	DG	125/250	1200
75	Cent. b.b.	D100X	125	1150
75	F.M. b.b.	DG	125	1800
75	Cr. Wh. bb (2)	CCD	250	1150
60	Whse. (2)	SK-143	250	1150
40	Whse.	SK-132	250	1150
35	Gen. Elec.	HC3E	125	1800
25	Whse.	SK93	125	1750
25	C.W. b.b.	CCD	250	1200

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Synch.	2200	514
700	Allis Ch.	Sq. Cage	440	900
600	G.E.	Slipring	2300	225
600	G.E.	Slipring	2300/440	600
500	G.E.	Sq. Cage	4000	1800
500	G.E.	Synch.	440	900
450	Allis Ch.	Synch.	440	450
400	Whse.	Sq. Cage	2300	514
400	G.E.	Synch.	440	450
350	Whse. (2)	Slipring	2300	450
300	F.M. b.b.	Synch.	2300/440	1500
300	Whse.	Sq. Cage	440	400
300	Rl. Machy.	Synch.	220/440	900
300	Al. Ch.	Sq. Cage	2300/440	720
300	Whse.	Synch.	2300/440	600
300	G.E.	Slipring	440	360
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2300/440	1200
250	L.A. (2)	Sq. Cage	440	1800
225	G.E.	Synch.	220/440	900
200	Whse. (2)	Slipring	2300/440	720
200	Gen. Elec.	Sq. Cage	220/440	1200
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2300/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2300/440	900
200	R. M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	G.E.	Slipring	220/440	900
150	Rl. Machy.	Synch.	220/440	900
150	Whse.	Sq. Cage	220/440	900
150	G.E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2300/440	720
150	G.E. (2)	Sq. Cage	2300/440	720
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
150	G.E. vertical	Slipring	4000/2300	1200
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Whse.	Sq. Cage	220/440	900
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G.E.	Slipring	220/440	450
125	Allis Ch.	Slipring	220/440	900
100	L.A. b.b.	Sq. Cage	440	3600
100	G.E.	Slipring	220/440	514
100	G.E.	Slipring	220/440	900

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	450	900
625	Allis Ch.	1 brg.	420	400
813	Gen. Elec.	ATB	240/480	900
300	F.M. b.b.	T	2300/480	1200
275	G. E. 30 cycle	ATI	480	750
225	Rl. Machy.		480	900
225	Gen. Elec.	ATI	240/480	900
150	Whse.		2300/480	600
125	Whse.		2300/480	900
75	Rl. Machy.		2300	900
68	G. E.	ATB	240/480	1200
37½	Whse.		240/480	1200

• These are only partial listings of our large stock — send us your inquiries for prompt attention and complete quotations. Quick shipment—fair prices—fully guaranteed. We save you time & money—safely!

SEND FOR WAGNER MOTORGRAM P-102

ARTHUR WAGNER COMPANY

1435 W. RANDOLPH ST.
CHICAGO 7, ILLINOIS
TELEPHONE MONROE 6-7409

TRANSFORMERS

25 & 50 KVA

General Electric, OISC, Type H, Form KO2, 33,000 volts primary, 2400/4160Y volts secondary 50/60 cyc., single ph. 4-2½% taps below 33,000 v. S/N 6,900,000. May be rewound:

33,000—120/240
33,000—240/480
33,000—600

MOTORS • GENERATORS • TRANSFORMERS
SALES • REPAIRS • RENTAL

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.

Paramount & 2nd Sts., Springfield, Mass.
REpublic 2-2104; 2-2105

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

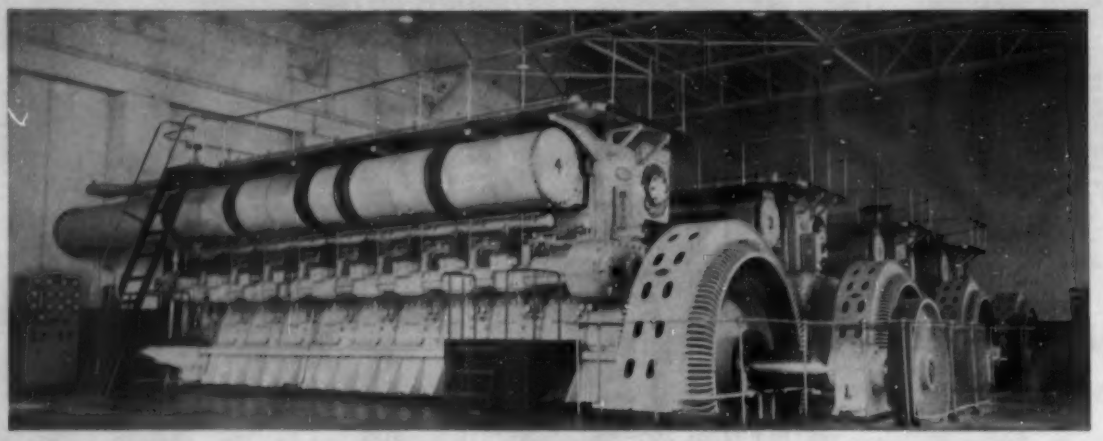
Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

8100 KVA DIESEL POWER PLANT
FOR SALE – Complete or As INDIVIDUAL UNITS



THREE (3) BUSCH-SULZER (NORDBERG) DIESEL ENGINES, 3060 HP, 9 cylinder, 2 cycle, 240 RPM, Type 9 DHB-27, direct coupled to: THREE (3) 2700 KVA, E. M. C. ALTERNATORS, 3/60/2300/4160 V.

Each Unit Complete with all Auxiliaries. NEW 1943—Can be inspected operating.

CAN BE PURCHASED FOR CASH, OR TIME, OR ON LEASE.

HEAT & POWER CO., INC.

60 EAST 42nd STREET • MUrray Hill 7-5280 • NEW YORK 17, N. Y.

---

3 G. M. 200 KW DIESEL GENERATOR SETS

Reconditioned by U.S. Navy

EQUAL TO NEW

Complete with motor driven starting air compressors, air tanks, dead front type generator switch panels and all other necessary accessories.

ENGINES

G.M. Model 8-268A—6½x7—1200 RPM—air starting—complete with engine operating panels, heat exchangers, cooling pumps, filters, strainers, governors, pyrometers, etc.

GENERATORS

Westinghouse 200 KW 250 KVA—440/3/60—1200 RPM—80% P.F.—continuous—drip-proof enclosure—direct connected exciter.

SIZE AND WEIGHT

Each unit, mounted on a pre-fab sub-base, is 19' 9 5/16" long, 3' 10½" wide, approx. 5' high. Weight of engine and generator only, 17,700 lbs. Each unit, with all accessories, about 27,000 lbs.

CONDITION

No expense has been spared to put these 3 units in "equal to new" condition. Don't miss this opportunity to buy! Inspection can be made at our warehouse, Curtis Bay, Baltimore.

THE BOSTON METALS CO.

313 E. BALTIMORE STREET

BALTIMORE 2, MD CURTIS 7-5050

---

30 HP, good for 200# Pressure, Boiler
250 & 300 KW Motor Generator Sets
550 KW GE Rotary Converter—Complete
100—125—150—200 HP Electric Motors
3—Complete Controllers for 300 KW MG Sets
10' Vert. Boring Mill, 134" Max. Swing
Package Boilers; 400 & 50 HP—oil fired
42"x50'x¼" Welded Steel Smoke Stack

H. & P., 6719 Etzel, St. Louis 14, Mo.

PUMPS

2—24" x 24" Dayton Dowd Centrifugal, 18,000 GPM, @ 35' Hd.
1—5" x 10" McGowan Hydraulic, 185 GPM, 500 PSI, #30005
1—3½" x 10" Worthington Hydraulic, Type D1654, 85 GPM, 500 PSI, #978859

TRANSFORMERS

100—1½ KVA, Line Material, Dry type, 120/240/480 volt primary, 120/240 volt secondary, with taps, 1 phase, 60 cycle.
3—150 KVA, Moloney, OISC, 4000 volt primary, 230/460 volt secondary, 1 phase, 60 cycle.
2—750 KVA, Wagner, OISC, 13200-240, 3 phase, 60 cycle, very modern.

BENSON-WILIMZIG, INC.

1704 North 8th St. St. Louis 6, Mo.

Phone GArfield 1-4290

LAND

EST. 1910

ELECTRICAL EQUIPMENT

A.C. & D.C.

MOTORS AND GENERATORS

One of America's Largest Stocks

RELIABLY REBUILT IN OUR OWN SHOP

1 YEAR GUARANTEE

Send us your inquiries

L. J. LAND INC.

148 GRAND ST., NEW YORK 13, N. Y.

Phone: CAnal 6-6976

---

900 HP ALCO DIESELS

Mod. 6-12½ x 13, 700 RPM Supercharged, Hydr. Coupling #5497-9, 3500, Very Low Price.

Excellent Condition — War Surplus

S. M. DAVIS, 510 LaSalle, St. Louis

–TRANSFORMERS–

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.

5318 Hetzel St. **Cincinnati 27, Ohio**

40 Years' Dependable Service

2000-KW. at 80% PF., **2500**-KVA.

A MODERN WESTINGHOUSE, 400# psig., 750°FTT., 2300-V. CONDENSING TURBINE-GENERATOR

AN EXCEPTIONALLY GOOD MACHINE

Unit is Complete with All Operating Auxiliaries.

Other Condensing Turbines Available:

ABOVE PHOTOGRAPH SHOWS MACHINE IS OF MODERN DESIGN

3000-KW G.E., 400# psig., 750°FTT., 1500-KW., 400# psig., 750°FTT. 3000-KW. Westinghouse, 400# psig., 750°FTT. All 2300-V. MANY OTHERS.

WE CARRY A FULL LINE OF DIESEL ENGINES AND BOILERS. *Send Us Your Specifications of Anything Wanted.*

PHONE, WRITE OR WIRE.

CHARLES WEAVER
19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

TEL. BROADWAY 3-1901.

250 KW COOPER BESSEMER DIESEL SET

Model FSN-6, 6 cyl., 4 cy. 900 RPM, air start Direct coupled to: General Electric Alternator, 250 KW, 3/60/440 V., 900 RPM, with direct conn. exciter. Incl. Accessories and Switchboard.

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn, N. Y.
STerling 3-6315

NEW AND USED ELECTRICAL EQUIPMENT

ELECTRIC POWER PLANTS · PLATERS · MOTORS · GENERATORS
MOTOR GENERATOR SETS · DIESEL AND GASOLINE POWER UNITS
ROTARY CONVERTERS · FREQUENCY CHANGERS · BLOWERS
HOISTS · ELECTRIC FANS · PUMPS · WELDERS
SPEED REDUCERS · COMPRESSORS · GRINDERS AND BUFFERS

BUCKEYE TRADING CORPORATION
1015 Papin Street • CHestnut 3110 • Saint Louis 2, Missouri

GUARANTEED REBUILT POWER EQUIPMENT

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
2000	G.E.	MT	600
1500	G.E.	MT-30	240
1250	Westg.	CW	900
1000	Westg.	CW	450
700	Al-Ch.	Any	720
500	Westg.	CW	350
400	Al-Ch.	S brg.	450
300	G.E.	IE-15A	1200
300	G.E.	MT-568	720
250	Westg.	HF-15H	600
250	G.E.	I-17B	450
200	G.E.	IK-15B	900
200	G.E.	IM-17	600
150	G.E.	MT-549	1800
150	Al-Ch.	Any-30F1	1200
150	Westg.	CW-908A	720
150	Westg.	CW	450
125	G.E.	IM-15A	900
100	G.E.	MT-558	720
100	G.E.	IM	600
75	G.E.	MT-346	1200
75	G.E.	MT-356	900
75	G.E.	MT-556	720
50	*Al-Ch.	ARY-220 BS	1800
50	Westg.	CW-636A	1200
50	G.E.	MT-336	900

MOTOR GENERATOR SETS

KW	MAKE	A.C.	D.C.
1000	G.E.	13,200	600
500	Westg.	2300	250
400	Al-Ch.	2300	120/240
400	G.E.	2300	270
300	G.E.	2300	250
200	G.E.	2300	250/275
200	Westg.	4160/2300	275
200	Ridgeway	2300	250
170	G.E.	440	125
150	Al-Ch.	2300	275
150	Westg.	2300	125/150
130	G.E.	440	275
100	G.E.	2300	250
100	Westg.	440	125
100	G.E.	440	125
75	Al-Ch.	440	250
75	G.E.	440	125
50	Reliance	440	250
50	Ideal	2300	250
30	Westg.	240	125

SQUIRREL CAGE MOTORS

3 phase 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
1250	*Al-Ch.	ANW	3600
1250	*Al-Ch.	ANW	1200
800	*Westg.	CS	3600
800	*Westg.	CS-1488	1800
700	*Westg.	CS	1200
700	Al-Ch.	AN	900
500	*Al-Ch.	6316-BW	1800
500	G.E.	KT-424	450
400	G.E.	KT-424	350
350	Ideal	A	1800
300	*G.E.	K-6344Y	1200
300	G.E.	K-6353 TEFC	720
250	G.E.	KT-5998	1800
250	*L.-Allis	OGK-148	720
200	*G.E.	IK	600
250	G.E.	IK-17A	900
250	Westg.	CS-14	514
200	*G.E.	PT-549Y	3600
200	*G.E.	KT-552	1800
200	*Cr-Wh.	SC	900
200	Al-Ch.	ARWWT	600
200	*Westg.	CS	600
200	Al-Ch.		514
150	Westg.	CS-81208 TEFC	1200
150	Westg.	CS-876C TEFC	900
150	Wagner	RB-1, 31-v	900
150	*Westg.	CS	450
125	*Westg.	CS-7TL, 8p-pf.	1800
125	Cr-Wh.	(2) Size 5QB	1200
125	Reliance	AA-C60858	900
100	Westg.	CS	1800
100	Westg.	CS-760	1200
75	Westg.	CS	1800
75	G.E.	KT-546	1200
50	G.E.	K-4444 TEFC	1800
50	Westg.	CS-642	1200

D. C. MOTORS

*230 Volt

HP	MAKE	TYPE	SPD.
250	Westg.	SK-228	450/600
200	Westg.	SK-201	650
200	Cr-Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
75/75	Westg.	SK-151	400/1600
50/120	G.E.	MCF	250/1000
50	Cr-Wh.	CMC	760/1140
50	G.E.	DLC	650
30	Cr-Wh.	CCM-50H	450
30/40	G.E.	CD-115	500/1500

CHICAGO ELECTRIC
carries complete stocks on all types of equipment
Write for Current Stock List or phone
CAnal 6-2900

CHICAGO *Electric Co.* 1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE
DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Eddystone, Penna. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
675	Fairbanks Morse	38D	960	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	Fairbanks Morse	32E14	450	300
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
148	Fairbanks Morse	32E14	225	300
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

ALTERNATING & DIRECT CURRENT UNITS STANDARD AND SPECIAL VOLTAGES AS REQUIRED

**—Indicates NEW unit*

ONE YEAR GUARANTEE!

A.G. *America's largest source of New and Remanufactured Diesel Power*

SCHOONMAKER CO., INC.

50 CHURCH ST., NEW YORK 7, N. Y.
PLANTS AND WAREHOUSES:
Eddystone, Penna. and Sausalito (S.F.), Calif.

CENTRIFUGAL PUMPS

3—20" Centrifugal Pumps 15000 GPM (Worthington pumps) 35' T D H, driven by 200 HP Gen. Elect. Motors, 2300 volt 220-440 720 RPM.

PAUL OBERMAN
1910 Delmar, St. Louis, Mo.

Rebuilt HEMPHILL *Guaranteed* EQUIPMENT

TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
1	1000	Amer.	Pyranol	3	4150x480
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600x120/240
1	750	G.E.	Auto	3	4150x2400
1	500	Kuhl	OISC	1	4600x2300
2	400	Pitts.	OISC	1	4150x240/480
1	333	G.E.	H	1	13200x220/440
3	150	American	OISC	1	2400/4160-240/480
2	75	G.E.	Pyranol	1	2400/4160-240/480

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1400	G.E.	514	ATI	4150
1	1000	Whse.	225	MIII	2300/4150
1	1000	G.E.	200	MIII	2300/4150
1	500	Whse.	450	HR	2300
1	300	EM	720	TEFC	2300
1	200	G.E.	600	ATI	600
1	200	Whse.	600	ATI	240
1	175	G.E.	720	ATI	2300
2	150	G.E.	1200	TS	4150
1	150	G.E.	1800	TS	220
1	150	Whse.	900	IRIG	220
2	150	Allis	300		2300
1	125	EM	900		4000
1	100	G.E.	900	TS	2300

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	200	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
1	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	900	IM	440
1	75	G.E.	900	IM	440
3	60	G.E.	1800	MT	220

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 3ph
1	1000	Whse.	720	600	2300/4150 3ph
1	1000	Whse.	720	275	2300/4150 3ph
1	300	G.E.	1200	150	2300/4150 3R
1	300	G.E.	1200	250	2300/4150 3ph
1	300	Whse.	900	250	2300/4150 3ph
1	150	G.W.	900	125	220/440 V
1	100	G.E.	900	250	2300 3ph
2	97	G.E.	1200	80	4150 3ph
1	75	G.E.	1800	250	220/440 3C
1	60	Whse.	1200	80	2200V
1	60	Whse.	1200	80	220
1	60	EM	1200	125	220
1	30	Whse.	900	250	440
2	25	G.E.	1750	240	220/440
1	25	G.E.	1800	250	220 V 3ph
1	30	EM	1800	125	220 V
1	7½	Allis	1800	125	220/440
2	5	G.E.	1800	125	220/440
3	1½	G.E.	2000	200 cy 1 ph	220/440
2	3	G.E.	1800	250	220/440

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	300	G.E.	1200	MPC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	50	C.W.	700	CM
1	50	G.E.	850	RC
1	25	Whse.	825	SK

FOR POWER
J.L. HEMPHILL & CO.
1603-54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK, LONGACRE 5-3237

SEARCHLIGHT EQUIPMENT SPOTTING SERVICE

This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised (this service is for user-buyers only).

Just send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE • NO OBLIGATION

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., New York 36, N. Y.

Please help us locate the following used equipment:

.....

.....

.....

.....

NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

8/55

O'Brien Offers—

MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—800 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220

DIESEL GENERATOR SETS

3—625 KVA Inger. Rand, 3/60/480/720 rpm
2—438 KVA GM-Winton 3/60/2300/360 rpm
1—375 KVA GM 8-268 Diesel 3/60/2400
3—200 KW GM Diesels Twin 671—3/60/220/1200 RPM
1—300 KW GM 8-268 Diesel 125/250 V. D.C.
3—100 KVA Cooper Bessemer 3/60/440
1—62.5 KVA 3/60/220 volt GM 671 Diesel
1—62.5 KVA 3/60/220 volt Superior Diesel
1—50 KVA 3/60/220 volt GM 471 Diesel
1—37.5 Kato 3/60/220 Continental Gas
4—31.25 KVA 3/60/220 volt Continental Gas
1—25 KVA LeRoi Gas 1/60/120/240
1—10 KW Wincharger 1/60/110-220 Gasoline

BOILERS IN STOCK

2—40,000 Lb. C.E. Package 400 P.S.I. Oil 1944
2—28,000 Lb. C.E. Package Oil 250 P.S.I. 1953
2—300 H.P. Cleaver Package Oil 150 P.S.I.
1—300 H.P. Superior Package Oil 125 Lb. 1954
1—150 H.P. O & S Package Gas-Oil 15 Lb. 1952
1—300 H.P. Superior Package Oil 15 Lb. 1950
1—100 H.P. Clayton Oil 160 Lb. New
1—50 H.P. Clayton Oil 160 Lb New
4—15 H.P. Columbia 150 Lb New
1—0 H.P. Columbia 150 Lb. New

ELECTRIC MOTORS

QU.	HP	Make	Type	Volts	Speed
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
2	200	West.	CW	2300	1800
1	200	G.E.	I.M.	440	514

JUST PURCHASED

3—300 H.P. General Motors Twin 6-71 Radiator Cooled Heavy duty Diesel Power Units New 1952—used 200 hrs.

TURBO GENERATORS

1—11250 KVA G.E. 3/60/13200/3600 rpm—Condensing—Boilers—Complete Plant

"Everything from a Pulley to a Powerhouse"

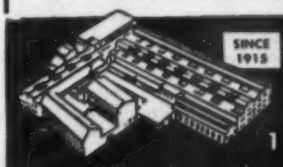
2—4000 KVA Allis Chalmers 3/60/2300/3600 rpm—Condensing
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 120 PSI 35 lb. B.P. New 1936.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—1040 CFM Chicago Pneumatic, GCB, Syn. Mtr. Dr. 3/60/220/100 PSI
1—978 CFM Sullivan 13x13x8. 45 psi
1—900 CFM C.E. 17x10x12—M.D. 3/60/220
1—871 CFM Schramm 7¼x5x4 100 psi
1—368 CFM I.R. 12x10, 100 P.S.I.
1—284 CFM Ing. Rand #50 Type 40, V-Belt Drive 50 H.P. 3/60/440 125 PSI
1—172 CFM Chicago Pneu 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
1	750	O'Brien New	13200	480	3
3	667	Al. Ch.	43000	2300	1
2	500	Wagner	33000	2400/4160Y	1
1	500	Gregory	4160	440	3
3	400	GE	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	250	Al. Ch.	13,200	115/230	1
3	250	Penna.	34500	120/240	1
3	167	G. E.	12000	2400	1
3	150	G.E.	13200	2300/4000Y	1
1	150	West	2300	230/115	1
3	100	G.E.	13200	120/240	1
3	100	West.	4160	240/480	1



SINCE 1915

THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LEADING MACHINERY DEALERS & EXPORTERS

1547 N. DELAWARE AVE., PHILADELPHIA 25, PA.

• Telephone GArfield 6-1150 • Cable Address O BRIEN PHILA.

AFFILIATED WITH SOC EXPANSO INDUSTRIAL SUL AMERICANA LTDA RIO DE JANEIRO—BRASIL

DIESEL GENERATOR SETS

3—1600 HP Fairbanks Morse Model OP 720 RPM, 1420 KVA FM 3/60/2400 volt generators. New 1949.

1—750 HP Superior 8 cylinder, 400 RPM, 500 KW Elec. Mchy. 3/60/2400 volt generator & auxiliaries.

3—600 HP Alco 6 cyl. 514 RPM, 400 KVA Elec. Mchy. 3/60/440 volts. New 1943.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St., St. Louis 1, Mo.

COMPRESSOR DIRECTORY

World's Best Rebuilts

All Makes
Many Sizes

Electric
Steam
Gas
Diesel

AIR

Air for Sale or Rent Since 1902

1 CFM to 5700 CFM
1 lb. to 3500 lbs.

American
AIR COMPRESSOR CORP
DELL AVE. & 47 th ST.
NORTH BERGEN, N.J.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

BOILERS *"Export Orders Carefully Executed"* **BOILERS**

TRY US with your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. **NEW YORK 7, N. Y.**

---

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	2300	Whse.	450
500	2300/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
300	2300/440	G. E.	720
300	440	G. E. (hoist)	900
300	2300	G. E.	300
200	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
200	440/220	Whse.	514
150(3)	440/220	G. E.	720
150	2300/440	G. E.	600
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2300	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G. E.	ATI	720
375	440/220	Whse.	O	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2300/440	G. E.	TS	1200
250	2300/440	G. E.	TS	750
250	440/220	Whse.	HR	277
150	440/220	G. E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2300	G. E.	PT	3600
500	2300/4000	Elliott	SC	1800
500	2300	G. E.		450
400	2300/600	Whse.	CS	720
300	440	L. Allis	PS	1200
225(2)	2300/440	G. E.	KT	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2300/440	G. E.	JK	900
200	2300	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2300	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	2300/440		KT	600

A. C. GENERATORS

1—830 kva, 600 rpm 2300/440/250 V., G. E.
1—300 kva, 900 rpm, 480/220 V., G.E.
1—225 kva, 90 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2300/440 V., G.E. (Hall)
1—187 kva, 1200 rpm, 2300/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E.
1—FKR-143, 1200 amp., 4500 V., G.E., Sol. op. (new)

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1870
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
90	230	G. E.	CD	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2300	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/230	Syn.	250/125
100	Al. Ch.	220/440	sq. cg.	240/120
100	Whse.	440/220	sq. cg.	125
75	G. E.	2300/440	Syn.	120
65	G. E.	2300/440	sq. cg.	250

TRANSFORMERS 60 Cy.

1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V.
1—333 kva, G. E., 13000—2300 V.
3—300 kva, G. E., 2300—575 V.
3—300 kva, G. E., 11000—2300 V.
2—200 kva, G. E., 4150—480/240 V.
2—150 kva, Al. Chal., 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

ACEC Electric Corp. ..... *
Air Preheater Corp. 161
Alco Products, Inc. ..... *
Allen-Sherman-Hoff Co. ..... Second Cover
Allis-Chalmers Mfg. Co. 53, 57, 64, 141
Alpax Company, Inc. 206
American Blower Corp. 32-33
American Engineering Co. ..... *
American Gilsonite Co. 253
American Pulverizer Co. 180
Ames Iron Works, Inc. ..... *
Anchor Packing Co. 201
Arkansas Fuel Oil Co. 197
Armstrong Cork Co. 51
Armstrong Machine Works 139

Babbitt Steam Specialty Co. 218
Babcock & Wilcox Co. 6-7-8-9
Babcock & Wilcox (Tubular Prods. Div.) 167
Badger Mfg. Co. 234
Bailey Meter Co. 12-13
Baldwin Hill Co. 219
Baltimore & Ohio Railroad 221
Barber Colman Co. ..... *
Belco Industrial Equip. Div., Inc. ..... *
Bell & Gossett Co. 155
Belmont Packing & Rubber Co. ..... *
Betz Co., W. H. & L. D. 137
Biddle Co., James G. ..... *
B-I-F Industries, Inc. 164
Bigelow Co. ..... *
Bin-Dicator Co. ..... *
Black, Sivalls & Bryson, Inc. 63, 192
Blaw-Knox Company ..... *
Boiler Engrg. & Supply Co. ..... *
Boiler Tube Co. of America ..... *
Bridgeport Brass Co. 246
Bros Boiler & Mfg. Co., Wm. 170
Brown Boveri Corp. ..... *
Buell Engineering Co. 198
Buffalo Forge Co. 229
Buffalo Pumps, Inc. ..... *
Builders-Providence, Inc. ..... *
Bussmann Mfg. Co. 70-71
Byron Jackson Company ..... *

Carey Mfg. Co., Philip ..... *
Cash Co., A. W. 237
Catawissa Valve & Fittings Co. ..... *
Champion Rivet Co. 238
Chapman Valve Mfg. Co. ..... *
Chase Brass & Copper Co. 60
Chemical Testing Corp. ..... *
Chesapeake & Ohio Railway 241
Chesterton Co., A. W. ..... *
Chicago Exposition of Power & Mechanical Engineering ..... *
Chicago Pneumatic Tool Co. 240
Childers Mfg. Co. ..... *
Cities Service Oil Co. 197
Clarage Fan Co. 242
Clark Bros. Co. 195
Cleaver-Brooks Co. (Boiler Div.) 179
Cleveland Fuel Equipment Co. 222
Cochrane Corporation 68
Coffin, Jr. Co., J. S. 188
Combustion Control Div. Electronics Corp. of America ..... *
Combustion Engineering, Inc. 26-27
Condenser Service & Engrg. Co., Inc. 196
Cooper-Bessemer Corp. 233
Copes-Vulcan Div., Continental Foundry & Machine Co. 14-15
Coppus Engineering Corp. 191
Corning Glass Works 208
Crane Company 4, 157
Crane Packing Co. 210
Crawford Fitting Co. ..... *
Cyclotherm Corporation ..... *

Darling Valve & Mfg. Co. 178
Dart Union Co. ..... *
Dearborn Chemical Co. 251
DeLaval Separator Co. ..... *
DeLaval Steam Turbine Co. 2
Deming Company ..... *
Denison Engineering Co. ..... *
Detroit Stoker Co. 20-21
Diamond Power Specialty Corp. 18-19
Dodge Mfg. Corp. ..... *
Dowell, Inc. ..... *
Dravo Corporation 218, 231
Drew & Co., E. F. 151

Eagle Picher Co. 250
Edison, Inc., Thomas A. ..... *
Edward Valves, Inc. 46-47
Electric Machy. Mfg. Co. ..... *
Elgin Softener Corp. ..... *
Elliott Company 10-11
Engineer Company ..... *
Erico Products, Inc. ..... *
Erie City Iron Works ..... *
Ernst Water Column & Gage Co. 230, 257
Everlasting Valve Co. 214

Felt Products Mfg. Co. 254
Fisher Governor Co. 217
Flexitallic Gasket Co. ..... *
Foster Engineering Co. ..... *
Foster Wheeler Corp. 49, 146-147
Foxboro Company ..... *
Frick Company 206
Fuller Company 52

Garlock Packing Co. 182
General Cable Corp. 159
General Electric Co. (Apparatus Dept.) 28-29, 35, 42-43, 173
General Precision Equip. Corp. ..... *
Goulds Pumps, Inc. 200
Graver Water Conditioning Co. ..... *
Green Fire Brick Co., A. P. 177
Green Fuel Economizer Co. 54
Greene, Tweed & Co. ..... *
Grinnell Company ..... Third Cover
Griscom-Russell Co. 255
Gulf Oil Corporation 145

Hagan Corporation ..... *
Hall Laboratories 65
Halstead & Mitchell ..... *
Hays Corporation 247
Hewitt-Robins, Inc. ..... *
Heyl & Patterson, Inc. ..... *
Hill Pump Valve Co. ..... *
Hills-McCanna Co. 224
Hoffman Specialty Mfg. Corp. ..... *

I-T-E Circuit Breaker Co. Switchgear Div. 205
Illinois Water Treatment Co. ..... *
Infilco Inc. ..... *
Ingersoll-Rand Co. 185
International Nickel Co., Inc. 236
Iron Fireman Mfg. Co. ..... *
Irving Subway Grating Co., Inc. ..... *

Jeffrey Mfg. Co. 215
Jenkins Bros. 143
Jerguson Gage & Valve Co. ..... *
Johns-Manville 48, 153
Johnson-March Corp. ..... *
Johnson Service Co. ..... *
Joy Mfg. Company 189, 235

Kaiser Company, E. B. ..... *
Kaiser Engineers, Div. of Henry J. Kaiser Company ..... *
Kato Engrg. Company 257
Keasbey & Mattison Co. 62
Kennedy-Van Saun Mfg. & Engrg. Co. ..... *
Kewanee-Ross Corp. 193, 266
Key Company 213
Kirk & Blum Mfg. Co. ..... *
Kittell Muffler & Engineering ..... *
Klinger, Ltd., Richard 169
Koppers Co., Inc. (Aeromaster Fans) ..... *
Koppers Co., Inc. (Coupling Dept.) ..... *
Koppers Co., Inc. (Engrg. & Const. Div.) ..... *
Kuljian Corporation ..... *

Laclede Stoker Co. 172
Ladish Company ..... *
Layne & Bowler Pump Co. 204
Leeds & Northrup Co. ..... *
Leslie Company 238
LimiTorque Corp. 245
Link-Belt Company 1
Lockett & Co., Ltd., A. M. ..... *
Lunkenheimer Company ..... *

Manning, Maxwell & Moore, Inc. 50, 184
Marley Company 32

Marsh Instrument Co. ..... *
Mason-Neilan Regulator Co. 30-31
McGraw-Hill Book Co. 252
McKiernan Terry Corp. 163
Mears-Kane-Ofeldt, Inc. ..... *
Mercoid Corp. 202
Mesta Machine Co. 181
Midcontinent Tube Service, Inc. 257
Midwest Piping Co., Inc. 67
Minneapolis-Honeywell Reg. Co. Industrial Div. 44-45
Murray Iron Works Co. 195
Murray Mfg. Co., D. J. 230

National Airoil Burner Co., Inc. 226
National Aluminate Corp. 67
National Coal Association 244
National Tube Co. ..... *
National Valve & Mfg. Co. 209
Nebel Machine Tool Co. 254
Niagara Blower Co. 202
Nicholson & Co., W. H. 237
Nordberg Mfg. Co. 243
North American Mogul Products Co. ..... *
Norton Company 58

Ohio Brass Co. ..... *
Ohio Injector Co. 223
Orr & Sembower, Inc. ..... *
Owens-Corning Fiberglas Corp. 56

Pantex Manufacturing Corp. 203
Peabody Engineering Corp. ..... *
Pennsylvania Flexible Metallic Tubing Co., Inc. 211
Pennsylvania Pump & Compressor Co. ..... *
Permutit Company ..... Back Cover
Perolin Co., Inc. ..... *
Petro ..... *
Philadelphia Gear Works 245
Philadelphia Pump & Machy. Co., Inc. ..... *
Phoenix Mfg. Co. (Flange Div.) ..... *
Pittsburgh Piping & Equipment Co. 72
Powell Co., Wm. 199
Powers Regulator Co. 129
Pratt Co., Henry 254
Pritchard & Co., J. F. 175, 239
Proportioneers, Inc. 164
Pure Oil Company ..... *

Raybestos-Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos-Manhattan, Inc. Packing Div. ..... *
Refractory & Insulation Corp. ..... *
Republic Flow Meters Co. 36-37
Republic Mfg. Co. ..... *
Republic Steel Corp. 38-39
Research-Cottrell, Inc. ..... *
Revere Copper & Brass, Inc. ..... *
Ric-Wil Incorporated ..... *
Ridge Tool Co. ..... *
Riley Stoker Corporation 102-103
Rohm & Haas Co. (Resinous Prod. Div.) ..... *
Roto Div. of Elliott Co. 216

Sarco Company 149
Schaub Engrg. Co., Fred H. ..... *
Scovill Mfg. Co. 64
Sinclair Refining Co. ..... *
Smith Corporation, A. O. ..... *
Socony Mobil Oil Co., Inc. 171
Solar Aircraft Co. ..... *
Sparkler Mfg. Co. ..... *
Spence Engineering Co. 59
Springfield Boiler Co. ..... *
Squires Co., C. E. 212
Standard Oil Co. of Indiana 225
Stephens-Adamson Mfg. Co. ..... *
Stickle Steam Specialties Co. 208
Stock Equipment Co. 207
Stockham Valve & Fittings ..... *
Stone & Webster Engrg. Co. 183
Strong, Carlisle & Hammond Co. ..... *

Taylor Instrument Co's. ..... *
Taylor & Co., W. A. 222
Tennessee Corporation ..... *
Terry Steam Turbine Co. 252
Texas Company ..... *
Todd Shipyards Corp. (Products Div.) ..... *
Toledo Pipe Threading Machine Co. 218
Tube Turns, Inc. 33-34

Union Asbestos & Rubber Co. 248
Union Iron Works ..... *
United States Gasket Co. 220
United States Gauge Div. of Amer. Machine & Metals, Inc. ..... *
United States Rubber Co. (Mechanical Goods Div.) ..... *
U. S. Steel Corp. ..... *

Viking Pump Co. ..... *
Vogt Machine Co., Henry 187

Wallace & Tiernan Co., Inc. 194
Walworth Company 249
Warren Steam Pump Co., Inc. 176
Watson-Stillman Fittings Div. 174
Western Chemical Co. ..... *
Western Precipitation Corp. ..... *
Westinghouse Electric Corp. 184
Westinghouse Electric Corp. (Sturtevant Div.) ..... *
Wheeler Mfg. Co., C. H. ..... *
Where to Buy 257
Wickes Boiler Co. 135
Wiedeke Co., Gustav ..... *
Wiegand Co., Edwin L. (Ind. Div.) ..... *
Wilson, Inc., Thomas C. ..... *
Wing Mfg. Co., L. J. ..... *
Worthington Corporation 16-17, 40-41
Wright-Austin Co. 186

Yarnall-Waring Company 34-35, 131
Youngstown Sheet & Tube Co. 55

Zallea Bros. ..... *

Professional Services **257**

CLASSIFIED ADVERTISING

H. E. Hilty, Mgr.

EMPLOYMENT OPPORTUNITIES 258

EQUIPMENT
(Used or Surplus New)
For Sale 258-263

WANTED
Equipment 258

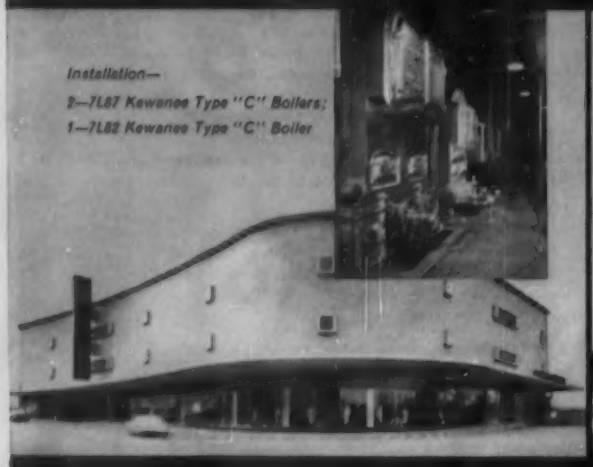
ADVERTISERS INDEX
Aljon Electric Diesel Co. 261
American Air Compressor Corp. 263
American Electric Service & Maintenance Corp 259
Atlantic Transformer Co. 258
Belyea Co., Inc. 259
Benson-Wilmzig Inc. 260
Boston Metals Co., Inc. 260
Buckeye Trading Corp. 261
Chicago Electric Co. 261
Chippewa Falls Woolen Mill Co. 258
Davis, Samuel M. 260
DeRose Corp. 259
Electric Service Co., Inc. 260
Hall & Co., Stephen 263
Heat & Power Co., Inc. 258, 260
Hemphill & Co., Inc. 262
H & P Machinery Co. 260
Iron Oxide Corp. 258
Jarrap Corp. 258
Land, L. J. 260
Marco Products Inc. 258
Mississippi Valley Equipment Co. 263
Oberman, Paul 258, 262
O'Brien Machinery Co. 263
Rearick, Charles B. 263
Schoonmaker Co., Inc., A. G. 262
Soul Clinic Inc. 258
Wagner Co., Arthur 259
Weaver, Charles 261

"Operating-Maintenance Costs Cut with Kewanee Boilers"

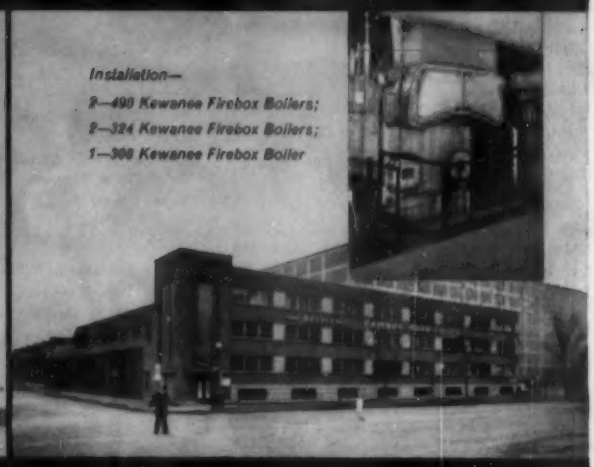
Noel Spannagel, Chief Engineer, Famous-Barr Company

Installation—
2—7L89 Kewanee Type "C" Boilers

Heating Contractor: Eichler Company. Architects: P. J. Hoener; Engineer: John D. Falvey



Installation—
2—7L87 Kewanee Type "C" Boilers;
1—7L82 Kewanee Type "C" Boiler



Installation—
2—490 Kewanee Firebox Boilers;
2—324 Kewanee Firebox Boilers;
1—900 Kewanee Firebox Boiler

Heating Contractor: Eichler Company. Architects: Will Ivey

KEWANEE reserve plus rated boilers

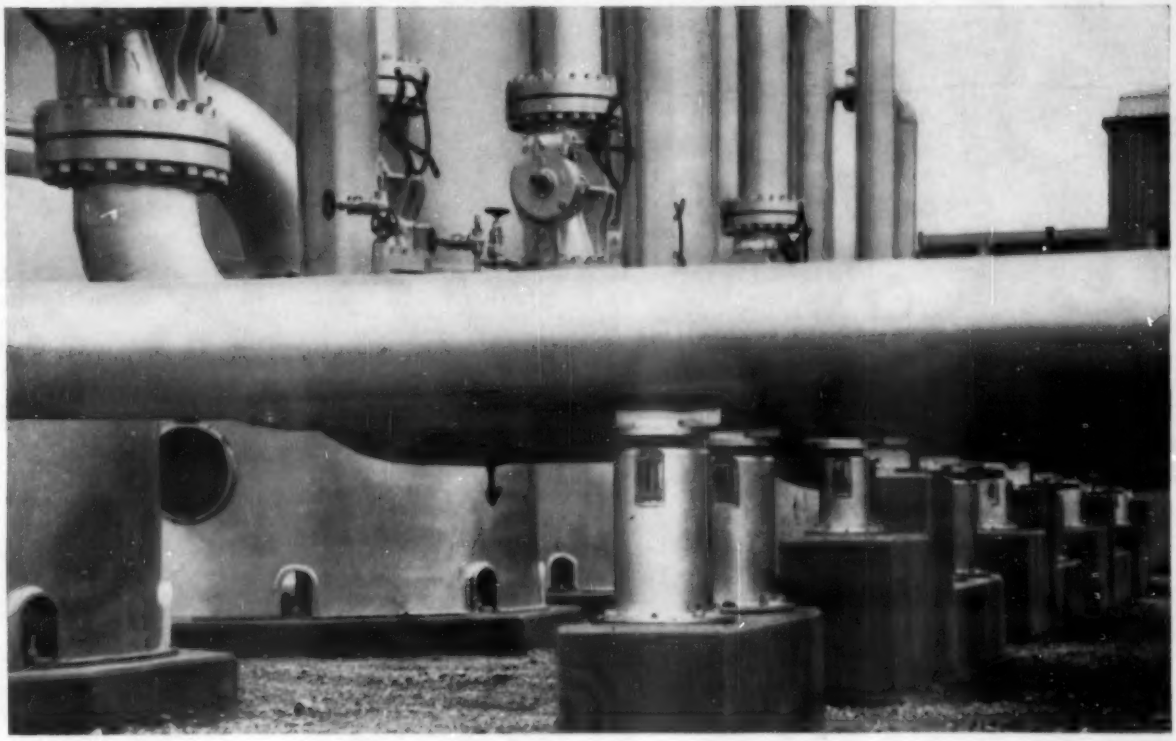
...PREFERRED BY FAMOUS-BARR FOR OVER 1/4 CENTURY

Back in 1928 the Famous-Barr Company, St. Louis, installed 2 Kewanee Stoker Fired Boilers in a warehouse . . . so began an experience with Kewanee Boilers that has extended over the past quarter century. As they expanded, as new buildings called for more power, Kewanee was the preferred boiler installation every time. But let Noel Spannagel, Famous-Barr's chief engineer, tell the story:

"My previous experience proved Kewanee offered important savings in operating and maintenance as compared with other boilers." Famous-Barr long has known the advantages assured by Kewanee Reserve Plus Rated Boilers such as provision for expansion—"cruising speed" operation which lowers operating and maintenance costs and lengthens boiler life. So when you consider boilers, be sure they are rated on nominal capacity to operate at "cruising speed."

Don't be misled by promises that a boiler delivers steam to meet average daily requirements. Only a boiler rated on nominal capacity can guarantee performance beyond the call of usual duty.

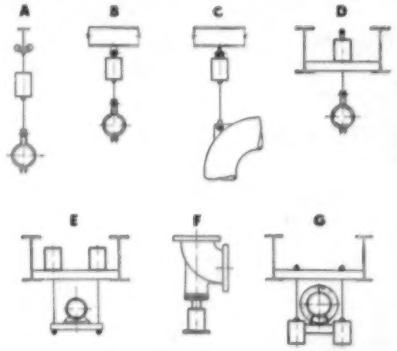
YOU can depend on KEWANEE engineering



For *flexible* support of piping

Grinnell Pre-Engineered Spring Hangers

AVAILABLE IN 7 TYPES FOR THESE TYPICAL APPLICATIONS



(Type A) Rod threaded to top cap (Type B) Furnished with single lug (Type C) Two lug style (Type D) Top adjusting (Type E) Adjustable top and bottom (Type F) For base support (Type G) Trapeze assembly.

The Grinnell Pre-Engineered Spring Hanger was developed after years of experience in analyzing the problems of flexible pipe suspension systems. It is *pre-engineered* to minimize changes in supporting force over total range of movement. Consider these outstanding features:

- **Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.**
- **Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.**
- **Solid steel casing protects spring from damage and weather. Guides assure continuous alignment and concentric loading of spring.**
- **18 sizes available from stock for load ranges from 53 lbs. to 12,000 lbs.**
- **Available in 3 spring lengths for travel ranges of 1¼, 2½, and 5 inches.**
- **Installation is simplified by integral load scale and travel indicators.**

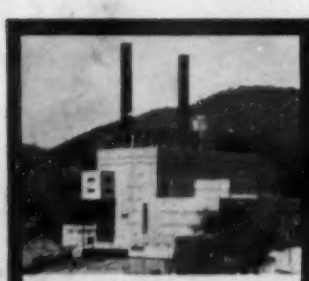
***Precompression is a patented feature.**

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

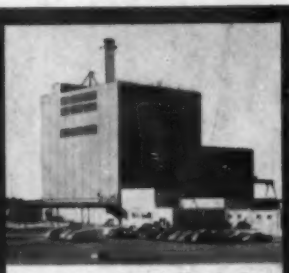
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Appalachian Electric Power Co. Kanawha Riv. Plant, Glasgow, W. Va.

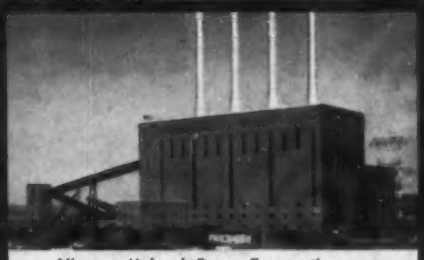
Florida Power & Light Company Cutler Power Plant, Miami, Fla.

Los Angeles Dept. Water & Power, San Fernando Valley Steam Plant

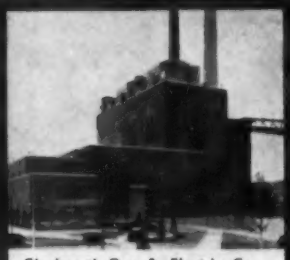


San Diego Gas & Electric Co. Encina Station, Carlsbad, Cal.

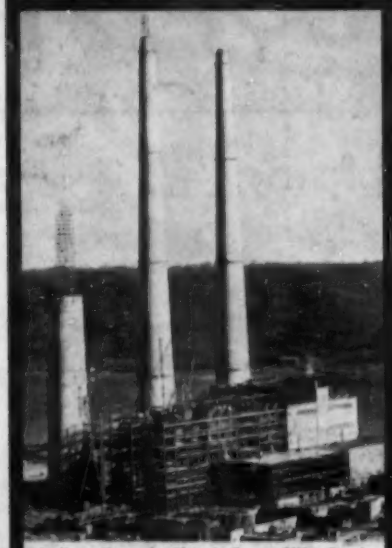
Ohio Valley Electric Corp., Kyger Creek Plant, Cheshire, Ohio (Power for AEC's Portsmouth area project.)



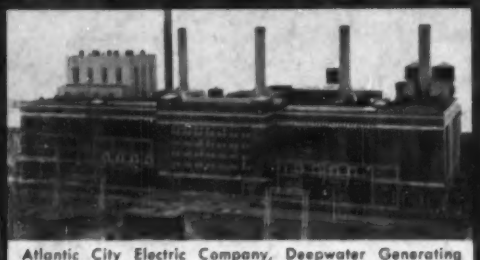
Niagara Mohawk Power Corporation Albany Steam Station, Albany, New York



Cincinnati Gas & Electric Co. Beckjord Sta., New Richmond, O.



Indiana-Kentucky Electric Corp., Clifty Creek Plant, Madison, Ind. (AEC Portsmouth project.)



Atlantic City Electric Company, Deepwater Generating Station, Penn's Grove, New Jersey

Metropolitan Edison Company Titus Station, Reading, Penna.

Gulf States Utilities Company, Baton Rouge, La. World's largest make-up demineralizers.

Illinois Power Company Hennepin Power Station, Illinois

Why these power plants chose PERMUTIT® *water conditioning:*

Some chose Permutit for its world-known engineering experience in thousands of utilities and industrial power plants . . . covering every major development in water conditioning from the first zeolite water softeners to the most modern demineralizing systems.

Others chose Permutit for its complete, integrated service: the water-analysis labs, engineering, equipment, controls and ion exchange resins . . . from one source . . . under one responsibility.

But most of the designers of these plants chose Permutit because they have personal knowledge of many installations where Permutit equipment has given long years of efficient, trouble-free performance. They know that's what pays off in the long run.

The Permutit Company, Dept. P-8, 330 West 42nd St., New York 36, N. Y.

DEMINERALIZERS • ZEOLITE AND HOT PROCESS SOFTENERS • PRECIPITATORS • DEAERATING HEATERS • PRESSURE AND GRAVITY FILTERS • CHEMICAL FEEDERS • AERATORS • BLOW-OFF EQUIPMENT AND OTHER POWER PLANT SPECIALTIES.